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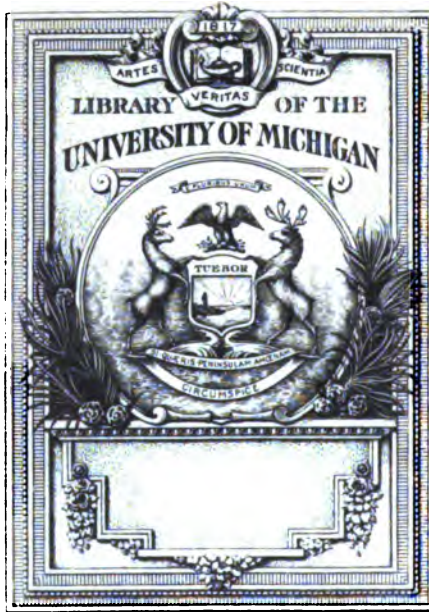
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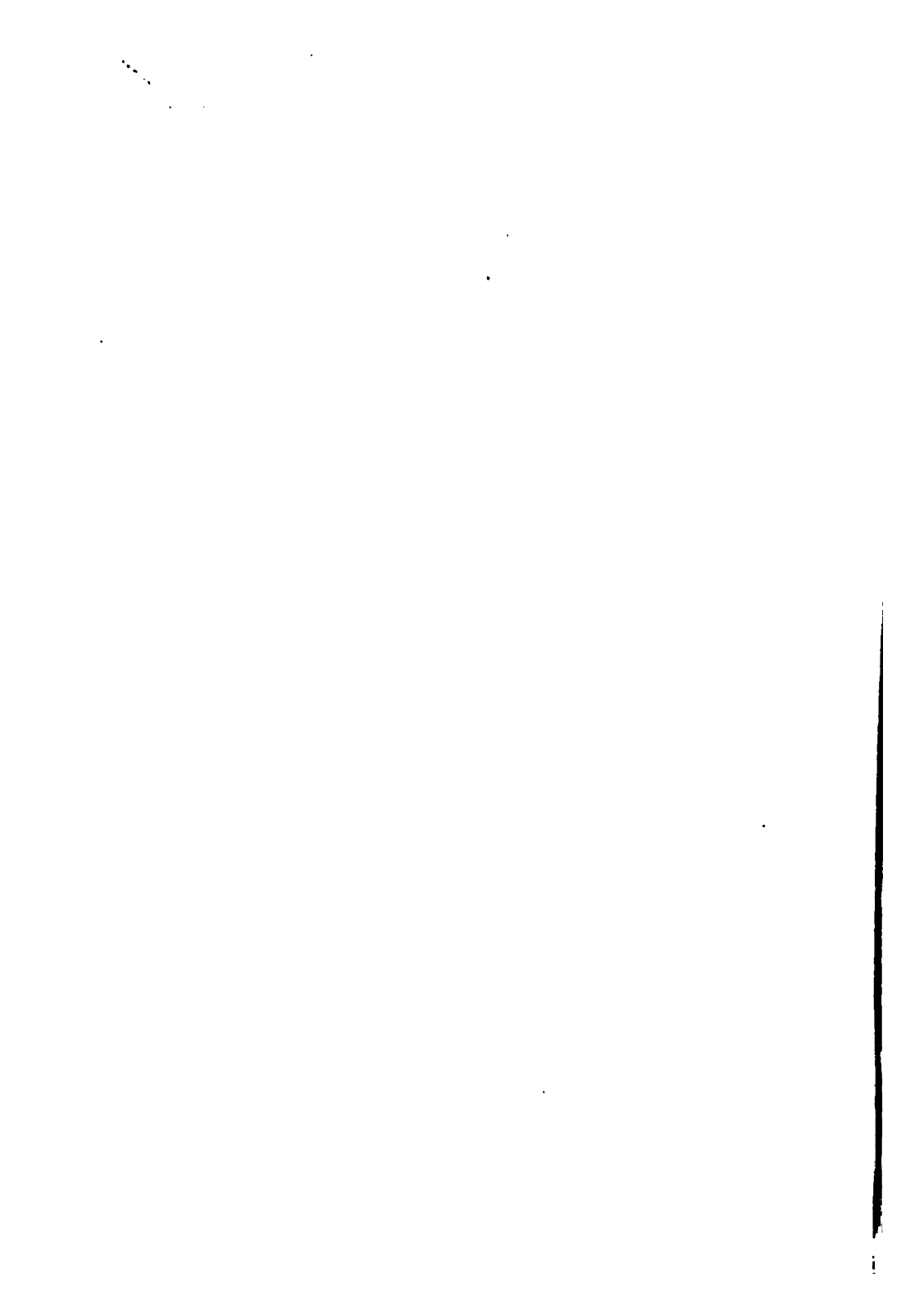
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**THE TWELVE-HOUR
SHIFT IN INDUSTRY**



American Society of Mechanical Engineers
Francis L. Stuart
THE TWELVE-HOUR *new*
SHIFT IN INDUSTRY

by

**THE COMMITTEE ON
WORK-PERIODS IN CONTINUOUS-INDUSTRY
OF THE
FEDERATED AMERICAN ENGINEERING SOCIETIES**

With a Foreword by
WARREN G. HARDING
President of the United States



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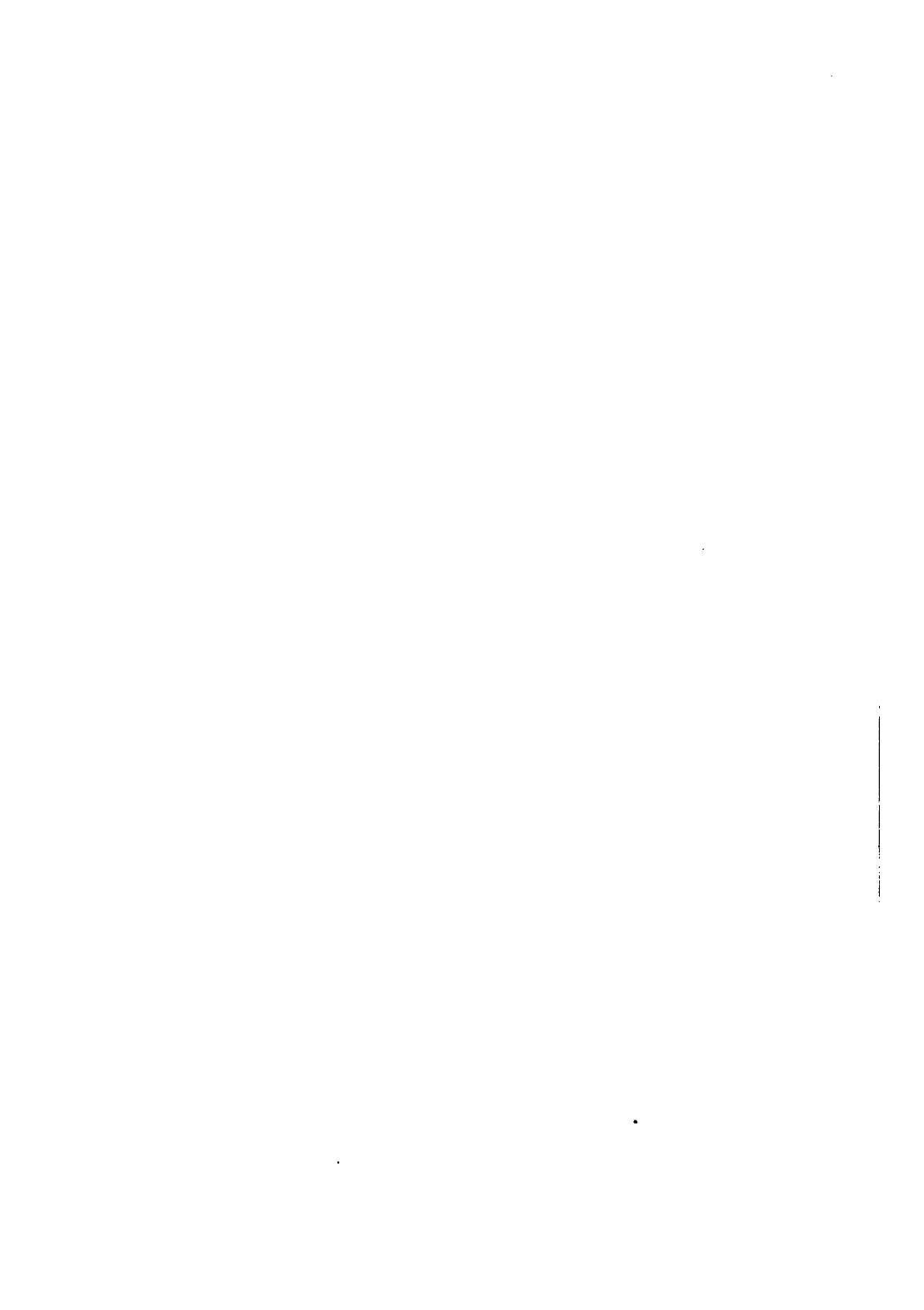
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FOREWORD

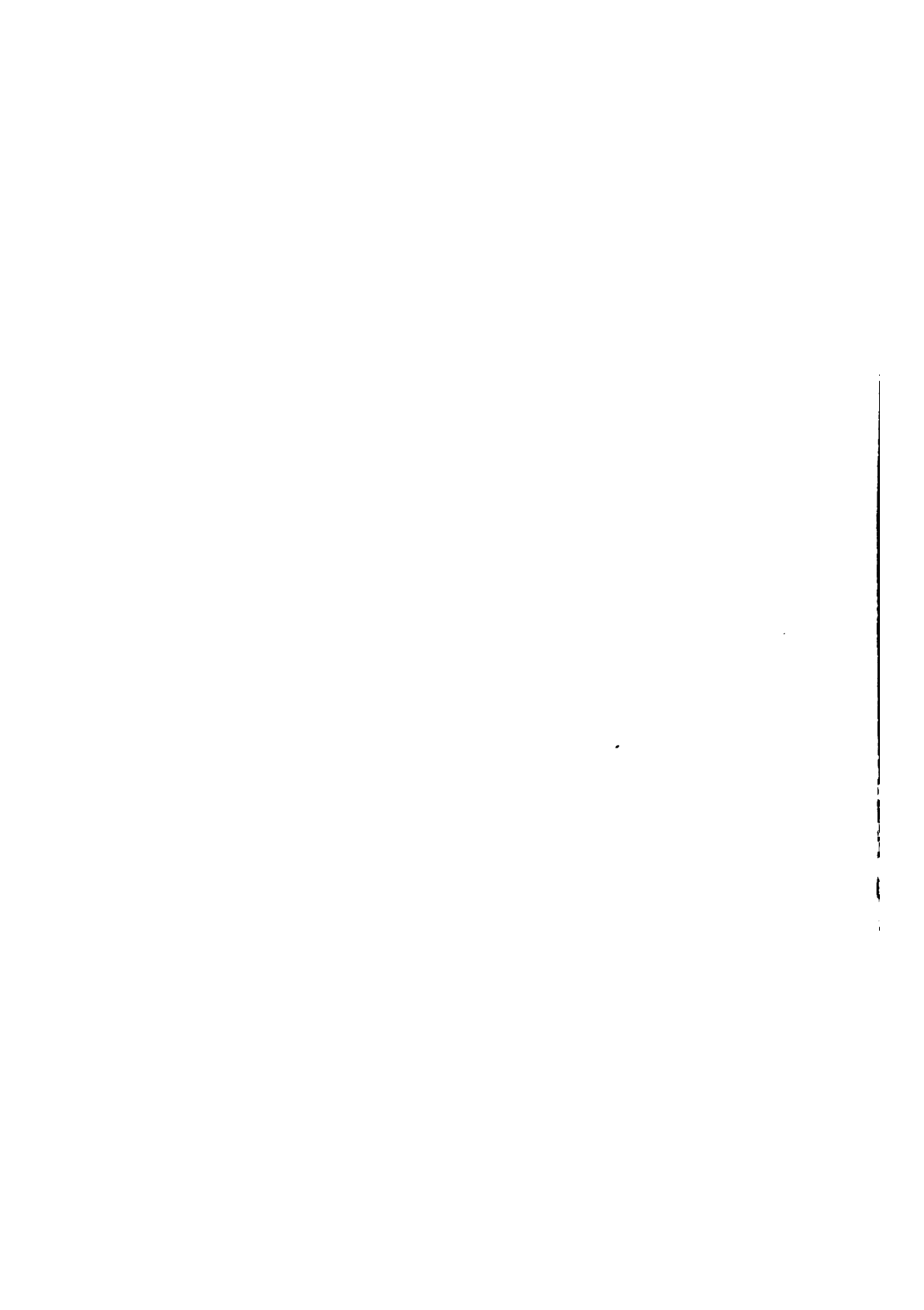
It is a matter of very much gratification to me that the Federated American Engineering Societies, our foremost organization of American industrial skill, should have given two years of diligent inquiry, under competent experts, to a subject which is of very deep interest to me, and important to the country.

I rejoice to note the conclusions of this great body of experts are identical with those which I have reached from a purely social viewpoint. It has seemed to me for a long time that the twelve-hour day and the type of worker it produces have outlived their usefulness and their part in American life in the interests of good citizenship, of good business, and of economic stability. The old order of the twelve-hour day must give way to a better and wiser form of organization of the productive forces of the nation, so that proper family life and citizenship may be enjoyed suitably by all of our people.

This clear and convincing report of the engineers must prove exceedingly helpful in showing that this much to be desired result can be achieved without either economic or financial disturbance to the progress of American industry.

WARREN G. HARDING.

THE WHITE HOUSE, WASHINGTON,
November 9, 1922.



**THE TWELVE-HOUR
SHIFT IN INDUSTRY**



Part I
SUMMARY OF DETAILED REPORTS



THE TWELVE-HOUR SHIFT IN INDUSTRY

CHAPTER I

INTRODUCTION

BASIS OF THE STUDY

IN 1920 members of the engineering profession began an organized study of the twelve-hour shift or "long day" in the operation of continuous-process industry. The spirit of the investigation reflected the firm faith of the engineers in facts, and the method adopted was that of fact finding and fact using. Such a study is within the purview of engineering activities, for engineering includes "the art of organizing and directing human activities" in connection with "the forces and materials of nature."

The first engineering meeting devoted to this subject was held in October of the year mentioned at the Engineers' Club of Philadelphia. The topic considered was the technique of changing from the two-shift to the three-shift system in continuous-process industries.¹ The papers and discussions at this meeting gave experiences in changing the basis of operation in the manufacture of paper, heavy and light chemicals, oil and cement, and in mining, in supplying water and in several other industries. A common technique was apparent throughout all these experiences. The record of this meeting,

¹ See Journal Philadelphia Engineers' Club.

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however, did not show to what extent these successful though isolated cases had influenced the respective industries to which they belonged.

Shortly after this meeting an investigation was conducted to determine the progress made in the steel industry in changing from the two-shift day. This investigation was directed by Morris L. Cooke. The study was made possible by a grant from the Cabot Fund, and the field work was done by Horace B. Drury. In Mr. Drury's report, made at a joint meeting of engineering societies held in New York in December, 1920,² there were listed about twenty steel plants, some large but many of them small, which had changed from the two-shift to the three-shift system with more or less success. It was recognized and stated that the problem of working a like change in the plants of the U. S. Steel Corporation and the large independents, such as Jones & Laughlin and the Bethlehem Steel Company, was quite different from that encountered in the smaller plants.

Early in 1921 the Taylor Society requested the International Labor Office at Geneva to inquire into the status of two-shift work in countries other than the United States. A report was recently issued from the Washington office in memorandum form³ to the effect that the shorter day is now completely established in the fifteen foreign countries answering the questionnaire. Early in 1921 also, Mr. Drury completed an inquiry into the twelve-hour shift problem as regards the larger steel manufacturers in the United States, a report of which was issued in proof-sheets in 1922 by the Cabot Fund Trustees. Finally in the same year, 1921, the Cabot Fund made a grant to the Federated American Engin-

² See Bulletin of the Taylor Society, Vol. VI, No. 1.

³ For summary see International Labor Review, Oct. 1922. The International Labor Office has published the replies in full. See Studies and Reports, Series D (Wages and Hours) No. 3, Geneva, Sept. 1922. Pp. 156. A summary was printed in the Iron Age, Vol. 109, No. 20, May 19, 1922.

ering Societies to carry on the two studies presented in this volume. The committee on Work Periods in Continuous Industry was appointed to direct the investigation.

LINES OF INVESTIGATION

To Horace B. Drury the committee assigned the task of ascertaining:

1. The extent of two-shift work in continuous-process industries other than the manufacture of iron and steel.
2. The experience of those manufacturers who had changed from two-shift operation to the three-shift or some other system.

To Bradley Stoughton the committee assigned the task of studying the technical aspects of changing from a two-shift to a three-shift system in the iron and steel industry.

GENERAL CONCLUSION

There is no direct relationship between the question of abandoning the twelve-hour shift system and the question of adopting the eight-hour shift system. In a sense it is accidental that most employers in changing from the long day have been forced by the mathematics of the situation to adopt a system of three shifts of eight hours each. Certainly the change itself has involved no judgment as to the relative merits of a working day of eight hours as compared with a working day of any other length shorter than twelve hours.

Relatively, only a small part of industrial work, 5 to 10 per cent, is on processes which require continuous operation and the number of workers is relatively few. The desirability of abandoning the two-shift system lies not in the extent

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to which it is used but in the fact that the twelve-hour shift day is too long when measured by twentieth century ideas as to the proper conduct of industry. Decisions are influenced today by humanitarian considerations as well as by the economic demand for that length of a day which will in the long run give maximum production. This declaration the Committee believes is not controversial.

Further, there is practical unanimity of opinion in industry as to the desirability of the change provided the economic loss is not too great. The weight of evidence indicates that the change can usually be made at a small financial sacrifice on the part of the workers and of the management. Under proper conditions no economic loss need be suffered. In certain instances, indeed, both workers and stockholders have profited by the change.

Facts developed by the investigation definitely prove that there is no broadly applicable way of striking a balance between the losses and gains inherent in the change from the two-shift system of operation. If any one fact stands out above the others it is that the change cannot advantageously be made by fiat. Our judgment is that to effect the change suddenly or without adequate preparation is sure to cause lowered production. On the other hand it is our judgment that when the change is pre-planned and the cooperation of every one is enlisted gains will accrue to every one concerned—to workers, management, owners and the public.

CHAPTER II

A GENERAL SURVEY

THE LEADING CONTINUOUS-INDUSTRIES

THE Drury report is a general survey of all industries operating continuously twenty-four hours a day, with special consideration of industries other than iron and steel.

There are few continuous-industries which do not have twelve-hour plants. Of some forty or fifty continuous-industries a number are overwhelmingly on three shifts. The majority are partly on two shifts and partly on three shifts with three-shift operation in the preponderance. There are a half dozen industries in which two-shift operation is so nearly universal that it is difficult to find an exception. Outside the steel industry the total number of employees on eight-hour shifts is now considerably larger than the total number of employees on twelve-hour shifts. Taking into consideration all continuous-industries, between one-third and one-half of all workers on continuous-operation are on shifts averaging twelve hours.

The leading continuous-industries may be classified as follows:

Group I. Heat-Process Industries

Iron and steel	Lime
Non-ferrous metals	Brick
Glass	Pottery
Portland cement	

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Group II. Chemical Industries

Heavy chemicals	Glue
Fertilisers	Drugs, etc.
Explosives	Electro-chemical industries
Dyes	Sugar
Industrial alcohol	Table salt
Wood distillation	Petroleum
Refined corn products	Cottonseed oil
Soap	Other oils

Group III. Heavy Equipment Industries

Paper	Automobiles
Flour	Textiles
Rubber	Mines
Breakfast foods	

Group IV. Service Industries

Power	Street railways
Gas	Telegraph and telephone
Water supply	Mails and express
Ice	Policemen, firemen
Shipping	Watchmen
Railroads	

SITUATION IN VARIOUS INDUSTRIES

The situation in the iron and steel industry is set forth in detail in Part III of this study. The outstanding facts as to other industries may be briefly summarized as follows:

Non-ferrous Metals.

The three-shift system prevails in the non-ferrous metal industries. In the West the change took place twenty or more years ago. In the East and South it was completed during and subsequent to the war.

Glass and Cement.

Until recently the twelve-hour shift was the rule for workers about glass furnaces. At one window-glass plant

out of 1300 employees, one hundred and seventy-five are on a twelve-hour basis. About six years ago the Pittsburgh Plate Glass Co. went to three shifts and three years ago the example was followed by the majority of other plate glass producers. Glass bottle blowers have for many years been on a day of approximately eight hours. Among other workers in the glass industry, the day ranges from approximately eight hours to ten hours, with a few on twelve hours.

The cement industry is the second most important industry predominantly on two shifts. However, the largest company and the third largest company, as measured by 1920 output, together with a considerable number of the smaller companies, are on three shifts.

Lime.

About 15 per cent. of the men in the plants personally investigated were on shift-work. In most parts of the country the lime industry is uniformly on two shifts.

Brick and Tile, etc.

There are more than 100,000 men in the United States employed in this industry, of whom about 11,000 are on shift-work—for the most part on two shifts. In some Philadelphia plants men are on duty thirty-six hours at a stretch. In Illinois many plants have changed to the three-shift system.

Chemical Industries.

Most of the producers of heavy chemicals are on three shifts. Acid plant employees in fertilizer works are almost universally on twelve-hour shifts. The continuous process-workers in explosive, industrial alcohol and fine chemical plants are generally on three shifts. The Niagara Falls electro-chemical industries are on three shifts.

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Sugar, Salt, Petroleum, Cottonseed Oil, etc.

The Louisiana sugar mills are on twelve-hour shifts. One sugar factory in Texas tried three shifts and later reverted to two. The American Sugar Refining Co. changed to three shifts in 1918. Nearly all the beet sugar plants are on twelve-hour shifts; two hundred and ten out of the two hundred and twenty-five employees at one Michigan plant being so employed.

In the salt plants the twelve-hour day was formerly almost universal. In Michigan today most salt plants are on three shifts.

No examples of two-shift work were found in petroleum refining. The refineries of the Standard Oil group, as well as those of the "Independents," are uniformly on three shifts. Cottonseed crushing, during the months in which the plants are in operation, presents one of the largest twelve-hour shift problems. Nearly all employees are shift-workers in this industry.

Paper, Flour, Rubber, etc.

There are about 114,000 persons in the paper industry, a large proportion of whom are on continuous-operation work. Most of the plants operate on three shifts. Thirty per cent. of the shift-workers in Massachusetts were in 1912 on twelve hour shifts and 70 per cent. on eight-hour shifts. In 1921 one of the large associations of paper manufacturers reported 20 per cent. of the plants still on two shifts.

Practically all the large flour mills are on three shifts. Most rubber plants have operated under the three-shift system since their establishment. The preparation of cereal foods is usually on three shifts. Some plants use the three-shift operation for women and the two-shift for men.

Automobile plants usually operate on one or two shifts of

about eight hours each ; but one very large company fluctuates between two and three eight-hour shifts.

In the textile industry the three-shift plan is used to some extent in the North, but in the plants in the South two shifts are employed, the length of the shifts varying greatly. The hours of work in mines, because of the influence of trade unions and the nature of the work, are fixed at about eight hours per day, with some exceptions in auxiliary occupations, as for engineers, firemen and pumpmen.

Power, Gas, Water Supply, etc.

Work periods in power plants have sometimes been arranged for overlapping shifts of different lengths to provide for variations in the degree of activity. Public-service electric plants in practically every case, however, are now on eight-hour shifts. The power departments of factories have been run on the twelve-hour shift down to the last few years. At present there is a tendency to put engineers and firemen on three shifts. The proportion of shift-workers in gas works is large. In Philadelphia and outlying districts the ten-hour shift is used in conjunction with the eight-hour shift. The twelve-hour shift in gas manufacture is now rare. Water works plants require less labor for continuous-operation than any other public utility. Most plants are now on eight-hour shifts.

Ice manufacture has offered a large field for twelve-hour work, but a part of the ice industry is now on eight-hour shifts. Watchmen are almost everywhere on twelve hours. The other service industries are very largely on eight hours.

CONCLUSIONS

1. As to the extent of continuous work in American industry, there are upwards of forty continuous-industries operat-

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ing more or less completely upon a shift system. They employ between 500,000 and 1,000,000 wage-earners on shift-work. Their families constitute from 1,500,000 to 3,000,000 persons who are dependent upon earnings from shift-work.

There are 300,000 wage-earners working on twelve-hour shifts. They and their families number more than 1,200,000 persons.

2. While the usual alternative to the system of two twelve-hour shifts is that of three eight-hour shifts, other shift systems have been resorted to in a limited way, in changing from the twelve-hour shift. Among these are:

a. Operation for a period shorter than twenty-four hours in each calendar day, permitting of a cessation of work from two to four hours and thus establishing two shifts of ten or eleven hours each.

b. Arranging what is nominally a twelve-hour shift so that the actual work can be completed in ten or eleven hours.

c. Arranging overlapping shifts, thus securing three nine-hour or three ten-hour shifts in twenty-four hours.

d. Arranging nine- and ten-hour shifts on the five-shift plan.

3. On the part of an overwhelming majority of the plants which have changed from two- to three-shift operation no technical difficulties have been encountered. There is usually no relationship between the duration of the process and the length of the shift, whether the latter is twelve hours long, or a shorter period. The seeming disadvantage of having three men instead of two responsible for a given product, process, or equipment is overcome by standardizing procedure and establishing control through precision instruments.

4. The following factors should be considered in changing from two- to three-shift operation:

a. The readiness or unreadiness, of the men to do more work per hour under the shorter shift.

b. The responsibility of management as expressed in planning, supervision and control, which must be of a higher quality than usually prevails under two-shift operation.

c. The fluctuations in individual earnings and labor costs.

d. General industrial and economic conditions, as helping to determine the time for making the change.

e. The relationship of work periods for shift-workers and day-workers.

f. The relationship of wage-rates for shift-workers and day-workers.

g. The number of working days in a week.

h. The rotation of shifts.

5. It is not possible to give inclusive data as to the effect upon the number of shift-workers of the change from two- to three-shift operation, because of variations in conditions. In many plants the number of shift-workers has increased in proportion to the increase in number of shifts. In other plants the number of shift-workers has remained substantially constant when changing from two- to three-shift operation.

6. The effect of the eight-hour as compared with the twelve-hour shift operation on the quantity and quality of production has been satisfactory where good management and cooperation of labor have been secured. In practically every major continuous-industry there are plants which have increased the quantity of production per man as much as 25 per cent. In a few exceptional cases the increase has been much higher. Evidence shows also an improvement in quality of production following the reduction in the length of shifts.

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The change from two to three shifts has in practically every case reduced absenteeism and labor turn-over, and in a marked degree. There is little evidence to show that personal injuries to workmen have been reduced.

7. In changing to three-shifts hourly wage-rates have been most commonly increased about 20 or 25 per cent. But the character of the adjustment has varied greatly in accordance with existing economic conditions and the special circumstances of the plant.

8. There is a natural divergence of opinion as to the advantages and disadvantages of the three-shift operation, but the weight of the evidence and the most positive statements are in its favor.

9. The evidence is conclusive that the extra leisure time of the men under the shorter working day is used to good advantage. It is spent in gardening, truck-farming and in doing odd jobs which otherwise would have to be paid for or would not be done at all. Or it is used for recreation, for family or social life, or for following the individual's personal interests.

10. A few plants have reverted to the two-shift operation after a trial of the three-shift system. Their proportion, however, to the number continuing operation on three shifts is so small as to be negligible. The weight of evidence shows that when a plant changes to three-shift operation it is very unlikely that it will revert to the former system.

CHAPTER III

THE IRON AND STEEL INDUSTRY

SITUATION IN THE IRON AND STEEL INDUSTRY

THE Stoughton report deals with the change from the twelve-hour shift to the eight-hour shift in the iron and steel industry from the technical viewpoint. It deals with the practicability of making the change, its effect and the most economical method of changing.

In 1919, the United States Steel Corporation employed approximately 70,000 twelve-hour employees. Altogether, there are perhaps 150,000 wage-earners in the entire steel industry on twelve-hour shifts.

A wise executive policy takes into full consideration the importance of the intellectual, the psychological and the physical well-being of labor, realizing that an immediate saving secured by over-pressure inevitably becomes a loss in the long run. A refusal to cooperate on the part of the workers is an economic loss. Furthermore it is obviously of no permanent benefit to the men if their hours are shortened beyond the point where the industry can survive under competitive conditions.

The factors to consider in determining the economic number of working hours for a worker are:

1. His productivity.
2. His skill, carefulness, endurance, alertness, intelligence, judgment, regularity, morale and goodwill.
3. His attraction to the work—so that the industry may

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benefit from the maximum supply of labor of the highest type.

4. His persistence in the work so that once he is trained and his qualities known to the management he will remain an asset to the industry.

The twelve-hour day is strongly established in the iron and steel industry by long custom and by its unusual adaptability to production requirements. Recent progress, however, has been in the direction of a shorter day as well as in the reduction of the proportion of men on duty seven days a week. This is shown by the following tabulation which gives the percentage of men so employed.

PERCENTAGE OF MEN WORKING ON 12-HOUR BASIS

	Seven days per week		Twelve hours	
	1910	1920	1910	1920
Blast furnaces.....	75%	29%	69%	63%
Bessemer mills.....	18	12	65	75
Open hearth.....	24	17	76	50

One reason why the twelve-hour day has persisted in the steel industry is the irregularities in the operations, and therefore in the intensity of labor, which permit rest periods and avoid excessive fatigue due to twelve-hour employment.

Recent improvements in equipment and the adoption of electrical appliances have greatly decreased the frequency and the duration of interruptions of the different processes due to breakdowns, especially in the rolling mills. Moreover, mechanical and other labor-saving devices have lessened the severity of peak loads due to the processes themselves, both in respect to physical endurance and heat exposure. For instance:

1. Oxygen is used to open the tap hole, and a mud gun to close it.

2. The cast house with its severe manual labor has been replaced by an arrangement which allows the liquid pig iron to run directly into ladles supported on railroad cars. Under this arrangement a former crew of twenty-one men is reduced to five—sometimes to three men.

3. Ore and the materials formerly piled, shoveled and wheeled by hand are now handled from railroad cars to the furnace hopper entirely without manual labor. Six men handle two thousand tons when previously it required twenty-three to handle eight hundred tons. This enables the fillers to work continuously.

4. At the Ford plant (which is a blast-furnace only), instead of allowing the fillers to rest occasionally as is usual in the twelve-hour plants, with consequent lowering of the stock line level in the furnace and of the furnace efficiency, an automatic record is kept of the level of the stock line in the furnace, of the temperature of the top gases and of the time at which the charging skip makes its trips. Continuous adherence to the standards set can be insisted upon and the rest periods and furnace inefficiency eliminated because of the high wages and the eight-hour day. This condition affects the men in front of the furnace as well as the fillers.

These changes in blast-furnace operation have made possible:

- a. Reduction in number of workmen.
- b. Increase in overall efficiency.
- c. Elimination of the floating gang.
- d. Reduction of absences, tardiness, labor turnover.
- e. Greater regularity of operation and less loss of time.
- f. Fewer accidents and breakdowns.
- g. Less costly repairs.
- h. Decreased cost of production.

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It is emphatically asserted by blast-furnace managers working the eight hours that the higher grade of labor attracted by the shorter hours, the greater care and alertness, better work, and more skilful operation are all reflected in a saving in cost of production as enumerated in the last five items above. Cost figures are confidential but furnace operators working under the eight-hour day assured the investigator on more than one occasion that the cost of producing pig iron is less on the eight-hour than on the twelve-hour day.

At the Ford plant, although the men are paid seventy-five cents and upward per hour and work only eight hours—as compared with twenty-seven to thirty cents per hour at various twelve-hour plants visited—nevertheless they make pig iron cheaper than it can be bought. This is attributed to the greater efficiency of labor and of operation.

In the case of open-hearth furnaces:

1. The charging machine has greatly reduced the work of the crew on the charging platform.
2. Electric appliances for raising furnace doors, mechanical appliances for changing valves, etc., have reduced labor.
3. Oxygen is used in tapping and compressed air for repairing the hole. A mechanical appliance has replaced hand-shoveling of recarbonizer into the ladle. Repairs are made with the mud gun.

Economical open-hearth operation is dependent upon the care, expertness and loyalty of the men; the shirking of duty is costly. Carelessness is more likely to occur on a twelve-hour than on an eight-hour shift.

In the case of rolling mills eight-hour shift operation produces a decided increase of efficiency in the case of the lever men manifested in: increased output; less waste from

“cobble” or spoilage; less need of repairs; elimination of “spell hands.”

CHANGING FROM LONG SHIFT TO SHORT—NECESSARY
CONDITIONS

Successfully to change from the twelve- to the eight-hour shift certain definite preparations must be made.

1. The equipment must be in satisfactory condition to respond to increased intensity of operation
2. The cooperation of the workmen must be secured.
3. Necessary labor must be available.
4. The technical staff must be prepared to furnish full information regarding available labor-saving appliances.
5. Existing “bottle necks” must be eliminated and probable ones avoided.
6. Peak loads must be studied with special reference to the installation of mechanical appliances.
7. The change must not be made during a period of labor unrest:
 - a. After strife.
 - b. When bitterness exists.
 - c. When mutual confidence is lacking.
 - d. When labor is arrogant or elated by the defeat of the management.
8. The change must not be made too suddenly.
9. Management must be able to exert a strong influence against:
 - a. Tardiness and absence.
 - b. Deliberate shirking.
 - c. Misuse of extra hours of free time.
10. Where possible time studies of the work should be made to determine how much more the twelve-hour

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crew could produce per hour if it worked with greater efficiency. The same hourly rate for eight hours, as for twelve should be paid but a bonus should be added which will enable the men by becoming more efficient, to maintain their daily income.

Labor Costs and Total Costs.

The United States has the most profitable iron and steel industry in the world, making more money and yielding more output than all the rest of the world put together and exporting its product in successful competition with foreign countries. The majority of managers and executives with whom the matter was discussed believe that the good of the industry can be better served by eliminating the twelve-hour day than by increasing dividends, provided that, by means of labor-saving devices and in other ways this step can be taken without serious injury to the industry.

The fact that already many plants operate successfully on the three-shift system indicates that profits need not suffer if the change is made with wisdom. The cost of all blast-furnace labor according to either system, is less than one dollar per ton of pig. Judge Gary testified before the Lockwood Committee in June, 1922, that the U. S. Steel Corporation could produce at two dollars per ton less than its competitors. This shows what low overhead and expert technical skill can accomplish.

The operating labor in the case of pig iron is from 5.8 per cent. to 8 per cent. of the total manufacturing cost. Only a part of the labor in the steel industry is working the twelve-hour shift. If that labor was changed to the eight-hour shift and paid as much per day as it is now getting for twelve-hour work, even without securing any compensating advantages through increased efficiency, morale, etc., the total manufac-

turing cost of the product in the steel industry would be increased only from 3 to 15 per cent. This is in most cases less than the variations in cost already experienced by competing plants, due to difference in efficiency of equipment, technical skill, purchasing, location, capital resources, overhead expense and skill of management.

As a matter of actual experience it is known that some plants have changed from the twelve-hour to the eight-hour shift and reduced their labor costs. Others have reduced their total manufacturing cost. Others are operating eight-hour shifts with satisfaction to management and stockholders. Results in such plants may be summarized as follows:

1. Some plants which have adopted the three-shift system, though paying wages a little less than are paid in corresponding plants working twelve hour shifts, have sufficient labor, both skilled and unskilled.
2. The management believes that the shorter hours attract a better class of labor.
3. Every executive interviewed stated that there is a smaller labor turnover on the three-shift system than on the two-shift system.
4. Sufficient skilled labor can be trained in the plant if the change is made with the cooperation of the men, and if it is made gradually.
5. It is unnecessary to pay a full twelve-hour wage to skilled labor to secure a sufficient number to work the eight-hour shift.

Gains from the Three-shift System.

The change from the twelve- to the eight-hour shift has secured results sufficient to compensate in whole or in part for the extra cost:

1. Increased efficiency manifested in increased produc-

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tion per man per hour and per machine per day,
due to:

- a. Better physical and mental condition of the men.
- b. Better class of men attracted.
- c. Better conduct of operation.
- d. More uniform operation.
- e. Better quality of product.
- f. Less fuel used.
- g. Less waste.
- h. Less need of repairs to equipment.
- i. Longer life of apparatus.

2. Better morale resulting in:

- a. Less absence and tardiness.
- b. Less shirking.
- c. Better discipline, due to:

Better spirit of the men.

Greater pressure which foremen can and will exert because they do not have to hold back out of sympathy for tired men.

3. Elimination of the "floating gang," maintained in twelve-hour shift plants to give twelve-hour men a day off a week.
4. Greater prestige with the public—which is invaluable in time of strife.

GENERAL CONCLUSIONS OF WHOLE INQUIRY

There are certain outstanding conclusions in regard to the change from the twelve- to the eight-hour shift which occur in both the Drury and Stoughton reports:

1. The tendency throughout the world is toward the abolition of the twelve-hour shift.

2. In almost every continuous-industry there are plants which are operating on an eight-hour shift basis in competition with twelve-hour shift plants.
3. To make the change from the three-shift operation successfully and economically it is desirable that:
 - a. The majority of the workmen appreciate the value of the extra leisure.
 - b. The workmen be willing to concede something in the way of daily income. The plan which divides the extra labor cost equally between the men and the company has been acceptable in a number of cases.
 - c. A survey of the field be made for labor-saving equipment and methods of management which will facilitate the work after the change is made.
 - d. The plant management study equipment and methods of operation and make every possible change in the plant and in the organization to facilitate operation under the three-shift system.
 - e. All equipment be in condition to respond to increased intensity of operation.
 - f. The workmen be instructed in their duties under the new system and the cooperation of the whole organization be secured.
 - g. The extra trained labor required be available.
 - h. The time for the change be selected with great care. Periods of labor unrest must be avoided, the success of each step assured before another is taken.
5. In a number of plants where the change has been made with success the management reports these results:
 - a. Better physical and mental condition of workmen.
 - b. Improvement in class of workmen.
 - c. Less striking, tardiness, absenteeism and labor-turn-over.

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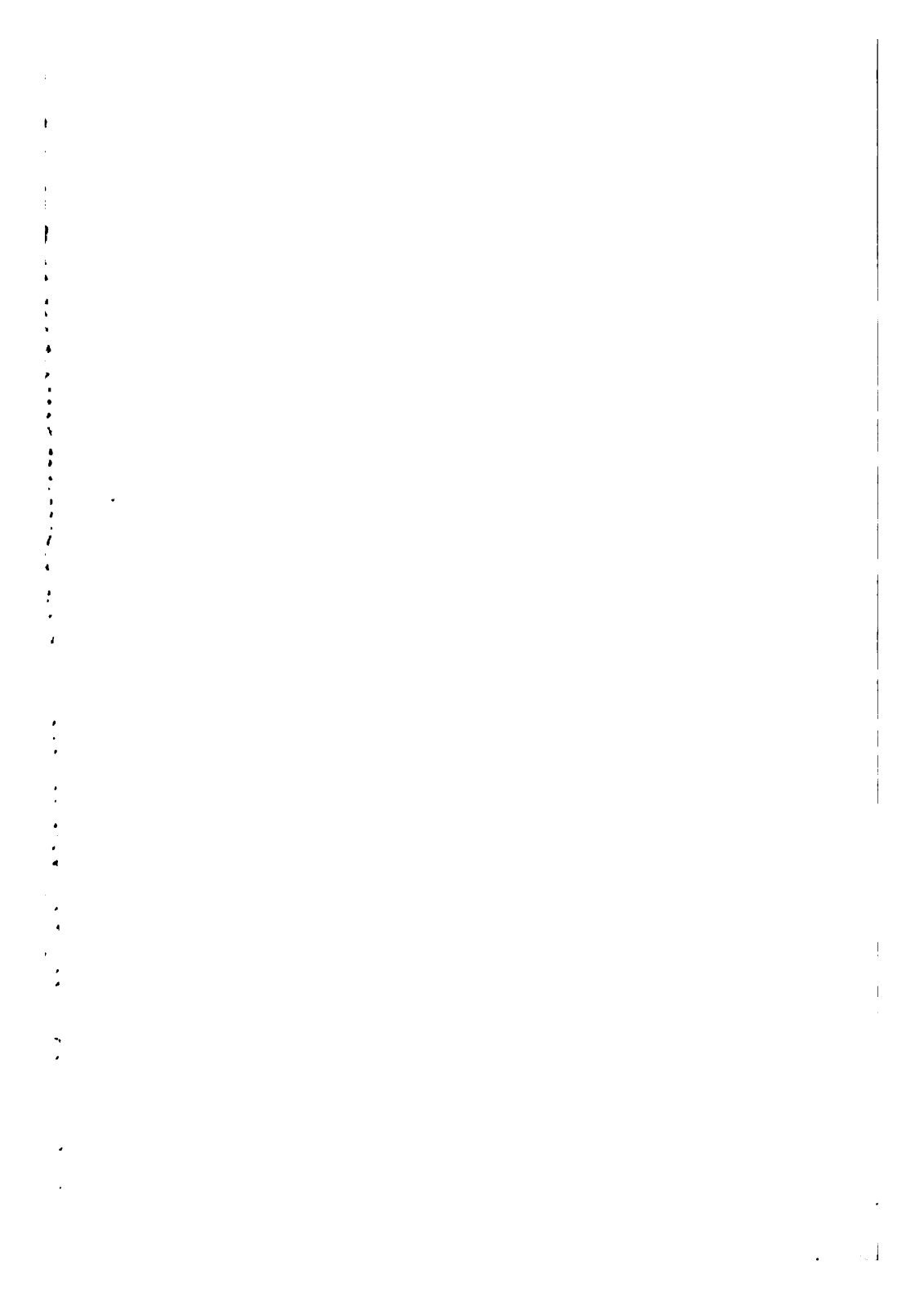
- d.* Improved spirit and cooperation of workmen.
- e.* More exact adherence to instructions as to working methods.
- f.* More uniform methods with consequent attainments of standards, etc.
- g.* Better quality of product.
- h.* Increased output per man per hour.
- i.* Less material used.
- j.* Wastes eliminated.
- k.* Longer life of equipment and less need of repairs.
- l.* Greater prestige with the public.

Part II
A GENERAL SURVEY

BY

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CHAPTER IV

THE PROBLEM IN GENERAL

WORKING CONDITIONS—IMPORTANCE IN INDUSTRY

THE people of the United States realize today more clearly than ever before that the main business and obligation of industry is to produce goods, and to produce them at as low a cost and in as great abundance as possible. But important as the production of goods obviously is, the effect of industry upon those who labor is hardly less vital. For many persons, that portion of their time devoted to labor constitutes a most important factor in their lives, either in what it introduces into their experience or in what it shuts out.

That is, the conditions under which men live during that part of the day devoted to work, the character which the task stamps upon mind and body, the sort of life outside of the shop which men's occupations permit them and their families to enjoy, these things have almost as important a share in determining the comfort and well-being of society in general as does the quantity of goods produced.

Hours of Labor—Interest in the Subject.

This clearer appreciation of what may be called the human factor in industry has led in recent years to the changing of industrial practice along many lines: to workmen's compensation and accident prevention; to the cleaning up and beautification of factories; to the establishment of relations between employers and employees so planned as to make men feel that they have an important relationship to a great

enterprise. However, of all the problems concerning labor, perhaps none has received more consideration than the question of hours. An interest in hours was indeed active for decades, if not a century, before much thought was given to safety or to many of the present policies relating to labor. It is patent that hours constitute almost as important a part of the industrial contract as does the wage-rate itself. They necessarily have some bearing on efficiency, on the pleasure of work and on the employee's health. So a century and more ago the question of hours was beginning to be a matter for legislation in England, first as regarded children and then as regarded women. And very early the trade unions began to take an interest in the subject, as did also some employers. The work-day which once had been twelve hours, or more, was reduced in the great majority of manufacturing industries to ten hours and in certain trades and sections it became eight. The expanded interest in working conditions which has marked the last decade has centered to a considerable degree around the question of hours.

Prior to the War the customary day for unskilled labor in most American industries was ten hours, for skilled mechanics it was often nine, but in some of the more strongly unionized trades it was eight. These variations in practice caused the question of hours to become a leading one, and in the course of the War an appreciable section of American industry went to an eight-hour day, especially in the West, and in cities and shipbuilding centers.

Immediately after the close of the War, most European countries definitely established the principle of an eight-hour day. In America, however, the question of hours, especially the question of a ten-hour versus an eight-hour day, is still a prominent issue. Employers, in many cases where the eight-hour day has been introduced, maintain that it would be to the interest of all concerned to return to a nine- or ten-hour

day. Organized labor, on the other hand, adheres staunchly to the principle of the shorter day. The attitude of individual employees is often in doubt—or at least in dispute.

Working Hours in Continuous-Industries.

There is, however, one aspect of the subject of hours which has received no adequate consideration; and that is the problem of working hours in the continuous-industries.

When persons speak of hours of labor they are thinking in almost all cases of the ordinary day turn which begins at about 7 in the morning and ends at from 3:30 to 5:30 in the afternoon. In the case of the day-work there is obviously no difficulty in adjusting the times of starting and stopping so as to give the desired number of hours. What the country, in its interest in hours, has not realized is that underlying the major portion of the nation's industry, which operates only by day, there are some forty or fifty industries where production is carried on throughout the twenty-four hours. In these industries, the number of hours worked per day is determined not by what would in itself constitute the best length of work-day, but by what is possible and practicable considering the requirement that the total of all the work periods must be an even twenty-four hours.

The division of twenty-four hours into ten- or nine-hour periods is a difficult matter. This fact, connected with the lack of enthusiasm on the part of managers of continuous-operation plants, and indeed of labor in many instances, in part accounts for the slowness with which the elimination of twelve-hour work has taken place. It is also true that many men on continuous work are employed in watching equipment rather than in doing great quantities of manual labor so that the physical strain and the lessened efficiency of a twelve-hour day are not so great as on most types of day-work. This no doubt accounted for the almost universal practice of making

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the duty of shift-workers two hours longer rather than two hours shorter than the common ten-hour day.

The twelve-hour day for shift-workers is still to be found widely distributed throughout the continuous-operation industries. But today it no longer holds the distinction of being the only practice. In most of the continuous-industries the question of three versus two shifts was not given serious consideration until within the last ten years and in most of the plants the matter did not come up for practical decision until the outbreak of the War. By 1920, there were in practically all of the continuous-industries some plants operating three shifts.

The transformation was, however, far from being complete. At the date of this writing (1922) there are few continuous-industries which do not have some twelve-hour plants. In many instances the volume of twelve-hour work is large. The present situation may be stated as follows:

1. Of some forty or fifty continuous industries, a number are overwhelmingly on three shifts.
2. The majority are partly on two shifts and partly on three, usually with three-shift operation in the preponderance.
3. In some half a dozen industries two-shift operation is still so nearly universal that it is exceedingly difficult to find an exception.
4. Outside of the steel industry, the total number of employees on eight-hour shifts is now considerably larger than the total number of employees on twelve-hour shifts.
5. Taking into consideration all the continuous-industries, including steel, it is probable that from one-third to one-half of all the shift-workers employed at the close of the last period of normal business activity were on shifts averaging twelve hours.

The Twelve-hour Shift—Lack of Information.

There is an unbelievable lack of knowledge pertaining to the twelve-hour shift. There are no statistics covering the matter of shift-work, nor has the government or any other agency collected figures which show the number of twelve-hour workers. The federal government, indeed, through the Census of Manufactures, and some of the states, as Ohio, Massachusetts, and New York, collect masses of figures on hours. But the state figures are usually union regulations, which generally do not apply to continuous-operation employees; while the voluminous statistics on hours collected for the federal census, and by the state authorities in Ohio, are no more than a report on the *prevailing* hours in the several establishments. In most continuously operated plants the hours of shift-workers are not the prevailing hours, more than fifty per cent. of the employees being on day-work, with hours different from those of the shift-workers. It is, accordingly, the length of the day worked by day-workers, which is in most cases reported for the entire plant. And the twelve-hour or eight-hour shift employees, amounting perhaps to twenty-five or forty per cent. of the total, are thus treated as though they did not exist, or rather as though they worked the same hours as the day-workers. On the other hand the reports from those plants where more than fifty per cent. of the employees work twelve hours show both day and shift-workers as working twelve hours. This, of course, is an exaggeration. Under certain circumstances a study of these reports is of help, as they point out where a twelve-hour day is to be found, but they do not present an accurate or even an approximately correct picture of the extent, or the distribution, of twelve-hour work.¹

¹ In the reports of the last Census of Manufactures (1919) the columns for hours "over 72," "72" and "between 60 and 72," which had been shown separately in the Census of 1914 and in earlier years, were merged. Thus the only information now available is for hours "over 60."

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Some information—but wholly inadequate—may be obtained from the more intensive studies of hours which have been made for a few specific industries. In 1912 the authorities of Massachusetts made a detailed study of the hours worked by both day-workers and shift-workers in the paper mills. The Federal Bureau of Labor Statistics in 1919 analyzed hours in a considerable number of industries. But these industries, like those for which the Bureau has at other times made studies, were in the main not continuous-industries. The figures were also for selected plants rather than for all plants. And the statistics gathered are for hours actually worked during a pay-roll period, rather than for the normal working day. They, therefore, give a day shorter than the actual day for every employee who was absent or out of employment for a part of the period. From the number of employees whose hours are put down as six, five, four, and even “under four” hours a day, it is apparent that this last method of counting hours, though of value when it comes to throwing light on employment and earnings, has detracted considerably from the availability of the statistics as an indication of the length of the working day.²

The best study of hours in a continuous-industry was made some ten years ago by what was then the Bureau of Labor, in the Department of Commerce and Labor. It was an extensive study of the twelve-hour day in the steel industry. At various times in the last decade or so there have been private inquiries affecting this one industry. The public has been informed to some extent with reference to the hours of shift-workers in the steel industry, and to a lesser degree, the paper industry. But aside from these two industries the pub-

² Also, the inclusion in the statistics of overtime has, in at least one instance, given the appearance of long hours, where they do not normally exist. Nevertheless, in the limited field which they cover, the figures of the Bureau of Labor Statistics are much more serviceable, for our purpose, than those collected by the census.

lie has had practically no information. As an evidence of the lack of general information almost all discussion relating to the twelve-hour shift has centered around the steel industry, as though the practice of twelve-hour shifts existed only there. The facts show that there are several times as much shift-work outside of the steel industry as there is in it, and approximately as many men working twelve hours. The other industries have had many times as much experience in changing from two to three shifts. In these industries, moreover, the elimination of what remains of the twelve-hour shift presents a more complicated problem.

Not only has there been little information available regarding the twelve-hour day in the continuous-industries, but only very fragmentary attention has been given by those most concerned. It was only with much difficulty that even the names of the continuous-industries could be ascertained. It has been rare to find any one person, whether government official, leader of industry, labor leader, or general student of industrial problems who could give the names of more than a few such industries. In the great majority of cases it was not believed by members of these groups that there was in existence such a thing as a twelve-hour day, save for the reports which had been heard concerning it in the steel industry. Even in the case of the trade associations in the continuous-industries, and of individuals who have had wide and lifelong knowledge of these industries, as a rule no one is informed correctly regarding shift practice. Hardly a person can speak with assurance or accuracy regarding the practice in the various sections of the country in the matter of two-shift or three-shift operation.

Strangest of all, the managers of continuous plants are not themselves informed regarding shift operation in other plants in the same industry. In most cases managers know what rates of wages are paid by their competitors, and

whether their men are organized, but are uncertain as to what shifts are run. In case they are posted they usually have no clear idea as to how shift systems have worked out. With few exceptions they are in almost absolute ignorance of what the practice is in other sections of the country. There is, of course, an approach to knowledge on all these subjects. There are rumors and surmises with regard to what may be done here or there, and occasionally definite knowledge. But the difference between what is believed and what is actually the fact is often exceedingly great.

PURPOSE OF THIS INVESTIGATION

The object of this investigation has been to ascertain:

1. What is the extent of continuous work in American industry?
2. What are the alternatives to the twelve-hour shift?
3. Are there technical difficulties in changing from two-shift operation?
4. What are the factors to be considered in changing from two-shift to three-shift operation?
5. How does the change from two-shift to three-shift operation affect the number of shift-workers?
6. What is the effect of eight-hour as compared with twelve-hour shift operation on the quantity and quality of production, absenteeism, labor turnover and industrial accidents?
7. How do wage-rates on eight-hour shift operation compare with wage-rates on twelve-hour shift operation?
8. What is the general opinion of managers of three-shift plants regarding three-shift as compared with two-shift operation?
9. Do employees make good use of the increased hours of leisure?
10. To what extent have plants reverted to two-shift operation?

CHAPTER V

THE CONTINUOUS-INDUSTRIES—SCOPE AND METHOD OF THE INVESTIGATION

THE CONTINUOUS-INDUSTRIES

For the purposes of this investigation the continuous-industries may be roughly arranged in four groups, in accordance with what are conceived to be the reasons for their being continuous. These groups may be designated as:

- Group I.* Heat-process industries.
- Group II.* Chemical industries.
- Group III.* Heavy equipment industries.
- Group IV.* Service industries.

They are exhibited in the following table:

TABLE 1

THE LEADING CONTINUOUS-INDUSTRIES

Group I. Heat-Process Industries

Iron and steel	Glass
Coke used in making steel	Flint glass
Non-ferrous metals	Bottles
Copper	Window glass
Zinc	Plate glass
Lead	Portland cement
Nickel	Lime
Aluminum	Brick
	Pottery ¹

¹ Usually only two or three per cent. of employees are shift-workers.

TABLE 1.—*Continued**Group II. Chemical Industries*

Heavy chemicals	Electro-chemical industries
Fertilizers	Sugar
Explosives	Louisiana cane sugar
Dyes	Refining of imported sugar
Industrial alcohol	Beet sugar
Wood distillation	Table salt
Refined corn products	Petroleum
Soap ²	Cottonseed oil
Glue	Linseed and other oils
Drugs, perfumes, fine chemicals	

Group III. Heavy Equipment Industries

Paper	Bakeries ³
Flour	Automobiles ⁴
Rubber	Textiles ⁵
Breakfast foods	Mines

Group IV. Service Industries

Electricity, power of all kinds	Street railways
Gas	Telegraph and telephone
Water supply	Mails and express
Ice	Policemen, firemen
Shipping	Watchmen
Railroads	

² Only a few soap plants operate continuously.

³ Operated as continuous-industry only in certain localities.

⁴ The Ford plant is operated continuously, some other plants most of the twenty-four hours.

⁵ Not usually continuously.

Heat-process Industries.

The first of the four groups, and the most important in the extent of continuous work, is made up of heat-process industries. The obvious reason for their operating continuously is the loss, often the prohibitive loss, which would come from allowing materials and furnaces to cool down and then start up again every day in the week. Indeed, some of the processes, as those in blast-furnaces and continuous glass

tanks, require several months to get into the best working shape, and entirely different methods would have to be followed if the furnace work were to be confined to eight or ten hours a day. In a sense, of course, these industries are usually chemical industries as well.

The heat-process industries as a whole fall into two major subdivisions:

1. The metallurgical;
2. Industries which burn or melt stone, sand, or clay to make glass, cement, lime, brick, tile, pottery, etc., which will be referred to as the ceramic group.

Among the metallurgical industries, the steel industry is preeminent, as, indeed, it is first among all the continuous-operation industries. This industry is continuous in character in almost all of its fundamental branches. Because of its size and the large proportion of continuous work, and also because it has been one of the slower of the continuous-industries to move towards the abandonment of the twelve-hour shift, it is almost as important a factor in the field of this study as all the other continuous-industries put together. The metal industries, other than steel, are at the present time almost without exception on a three-shift basis.

In the ceramic group, there are a number of industries in which the main work, so far as labor is concerned, is not continuous, but consists in the daytime shaping and movement of bricks, tile, terra cotta, etc. But the technically important process of burning the finished ware is continuous, as is also the operation of the power plants. In a typical twelve-hour brick plant (burning coal), about 11 per cent. of the men are shift-workers. In terra cotta and pottery, the per cent. would be much smaller (perhaps 3 per cent.). Lime, on the other hand, calls for a considerably larger proportion of shift-workers (perhaps 15 per cent.). Cement is continuous-

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operation, not only in burning, but, as a rule, in the major grinding operations which, together with the burning, make up the substance of the industry. The proportion of shift-workers in the various branches of the glass industry varies widely.

Excepting glass, all the industries in the ceramic group are predominantly operated on two shifts. Glass is mainly a three-shift industry (so far as there is shift-work at all).

Chemical Industries.

The chemical industries are considerably more numerous and diversified than the heat-process industries, but usually not large individually. Nearly all of the chemical industries have some continuous-process work; but usually only a part of the process is continuous, and usually the number of men employed in the continuous-operation departments is relatively not large. A few men can handle a great tonnage of acids or fats. Even where the continuous-operation equipment bulks large, a substantial majority of the employees may be on other than shift-work. The more important industries in Group II, in point of number of shift employees, are on the border line between the chemical and heat-process industries, or between the chemical industries and those whose chief distinction is their heavy equipment. Particular cases are the refining of petroleum, the crushing of cottonseed, and the sugar industry. Petroleum refining is on three shifts. Cottonseed oil manufacture, fertilizers, and the bulk of the sugar industry, are on two shifts. Most of the other chemical industries are partly on three shifts, partly on two shifts, with the preponderance in favor of three shifts.

Heavy-Equipment Industries.

The term "heavy equipment"—or "elaborate equipment" suggests a third great cause for continuous-operation. It is

one of the most significant causes, for in a way it underlies much of the continuous-operation in all of the groups named. A common designation for the unit of operation in a "heavy-equipment" industry is "mill." "Mills" are often at the heart of continuous-operation in industries of the most diverse type. They may be heavy mills, such as are used in the steel industry or in cane or cottonseed crushing, or small mills such as are to be found in the flour industry. But the equipment of a plant need not include a mill in the narrow sense of that term—revolving apparatus—in order to cause continuous-operation. Wherever there is heavy overhead and the possibility of increasing output greatly by employing a relatively small number of men to keep the equipment going continuously, there is a strong tendency towards continuous-operation. Indeed, continuous-operation may develop even where the number of employees is large, especially in rapidly expanding industries, or in times of great demand. Associated with the desire to save on overhead expense and turn out large output without multiplying equipment there are also substantial technical conveniences favoring the uninterrupted operation of certain types of mills or other heavy equipment. For example, in the paper industry it is a costly and hazardous matter (from the equipment standpoint) to stop and start the mills.

While this matter of heavy equipment is an important factor in many of the continuous-industries, it stands almost alone as a factor making for continuous-operation in the case of the industries listed in the table as Group III. Several of these industries are not as a whole on continuous-operation, but they are listed as being the seat of continuous-operation in certain plants at certain times. It must be remembered that the influence for continuous-operation of heavy equipment extends far outside of the industries listed as Group III.

Service Industries.

The fourth group is, technically considered, of a miscellaneous character. It consists, with a few exceptions, of public-service industries. A principal, though not always the only, reason for the continuous-operation of these industries is the fact that the services which they render are needed both by day and by night. But the service by night is not necessarily equal to the service by day, and the industries present many irregularities.

The lines of division between the four groups presented are far from rigid, the groups overlapping to some extent. Yet the arrangement of the industries in this fashion should be of assistance in bringing out the four forces in modern industry which make for continuous-operation.

TECHNICAL IMPORTANCE OF THE CONTINUOUS-INDUSTRIES

It would be hard to overstate the technical importance of the continuous-industries. Our contact with their products is as intimate as our knowledge of the breakfast table—as witness *sugar* and *salt*, the *breakfast food*, *bread*, the *silver* on the table, the *china*, the *glass*, the *ice* in the water, and even the *water* itself. It was a continuous-industry which supplied the *gas* for cooking, the *electricity* for lighting, also the *plaster* for the walls, *paper* to cover them, perhaps the very *colors* in the paper. We can little more than suggest the innumerable objects of *metal* or the *ceramic* arts which serve a useful or decorative purpose in almost every interior.

Note the place which the products of the continuous-industries occupy in the more general framework of a city. Consider *steel*, *concrete*, *brick*, *glass*, *terra cotta*, *cement*, *paving brick*, *steel rails*. Consider such services as those of *police* and *fire protection*; *watchman* service; *electricity*; *communication*; and *transportation*. Consider the ramifica-

tions of the *chemical* industries, and the innumerable uses of the *metals, clay products, paper, power.*

It would seem that with the rapid expansion of the chemical industries, with the constant introduction of more heavy and expensive machinery, and with the greater attention paid to securing maximum output from equipment, the importance of the continuous-industries will in the future be greater than at present.

AMOUNT OF SHIFT-WORK

The problem of labor-shifts in the continuous-industries is of somewhat less magnitude than the technical importance of the industries would suggest. Taking the country's industries as a whole, the continuous-operation stage usually comes at a point where products are handled in bulk. The industries which require large numbers of workmen are those which finish or fabricate, and as a rule these industries are on a day-work basis. In the continuous-industries it is very rarely that all the employees are on shift-work. In general, the process men are on shift-work. But the mechanics who construct and repair equipment, the common labor that loads and unloads cars and handles materials, the men and women who pack and ship goods, as well as those in finishing departments of various kinds, are on day-work only. So that in industries that seem thoroughly "continuous-process," the proportion of shift-workers frequently falls a little short of 50 per cent. Often it is in the neighborhood of 30 or 40 per cent. There are some partly-continuous-industries in which the proportion of shift-workers hardly runs over 10 per cent., if it is indeed that large. On the other hand, there are substantial industries, such as cottonseed crushing and beet-sugar refining, in which the proportion of shift-workers is very close to 100 per cent. Also some of the largest of the steel companies have had as high as two-thirds of all their employees

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on shift-work, while a ratio of 50 per cent. of shift employees is not at all uncommon.

Nevertheless, even counting only the employees actually on continuous work it is evident that the problem of two-shift versus three-shift operation is important. So far as can be judged from all available evidence there are between 500,000 and 1,000,000 American wage-earners on shift-work. Of these, probably 300,000 or not far from that number, were, at the close of the last period of normal industrial activity, still working twelve hours.*

METHOD OF SECURING DATA—VISITS TO PLANTS

The investigation of shifts in continuous-industry has been rendered more difficult by the fact that the continuous workers are scattered, not only in many different industries, but often in relatively small groups in plants where they are outnumbered by day-workers. Their diffusion among day-workers accounts for the lack of statistics covering their number. Doubtless, also, the absence in most cases of mass effect is one of the reasons why so little study has been given the problem of the twelve-hour worker.

These peculiarities, as well as the widespread lack of information, have prescribed rather definitely the course which had to be followed in the making of this investigation. To form anything like a correct or comprehensive view of the subject it has been necessary to go into the field and hunt the continuous plants, in as wide an expanse of the country as possible.

*As already pointed out (see page 31), there are no statistics covering this subject. In arriving at the above estimates, consideration was given to the number of men reported in the census as employed in each industry, and to evidence collected in the field with regard to the proportion of twelve-hour workers. Use was also made of such other statistical data as was available. But the estimates are necessarily very rough. This applies to the figures for all shift-workers, as well as to those for twelve-hour workers.

Extent of Country Covered.

Each continuous-industry has its several strongholds in particular sections of the country, and those were especially visited. But many plants, large and small, were also visited in other parts of the country. Table 2 shows the localities in which plants were studied or their managers consulted in person. Information was received by correspondence from many other points.

TABLE 2

PLACES VISITED FOR INVESTIGATION

New York City	Canton, Ohio
Buffalo	East Liverpool, Ohio
Metuchen, N. J.	Columbus
Camden, N. J.	Cincinnati, and suburbs
Glass manufacturing points in southern New Jersey	Middletown, Ohio
Bethlehem, Allentown, Nazareth, Palmerton, and other points in Lehigh Valley, Penn.	Franklin, Ohio
Philadelphia, and nearby Penn. points	Miamisburg, and W. Carrollton, Ohio
Pittsburgh, and numerous cities within radius of 40 miles	Dayton
Sharon, Pa.	Toledo
Washington, D. C.	Detroit
Richmond	Michigan cities along St. Clair River
Atlanta	Saginaw
Birmingham	Battle Creek
Chattanooga, and Richard City, Tenn.	Kalamazoo
Copper Hill, and Knoxville, Tenn.	Terre Haute
Newell, and New Cumberland, W. Va.	Chicago
Newport, Ky.	Gary
Cleveland	Danville, Ill.
Akron	Granite City, Ill.
Youngstown	Minneapolis
	St. Louis
	Kansas City, Kansas
	Denver
	Pueblo

The survey thus conducted could not in the nature of the case be complete. But the study was carried to a point where

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it was believed that it would give a substantially correct view regarding the size and nature of the shift problem in the United States.

Statements by Officers of Plants.

While many sources of information have been used, the report is based in the main on the statements of officers of the continuous-industry plants.

CHAPTER VI

THE METAL INDUSTRIES

IRON AND STEEL

THE steel industry has received separate consideration in three special reports which may be considered as parts of the present investigation.¹ In order, however, that this, by far the most important of the continuous-industries, may not be omitted from the general survey here given, there will be inserted a sketch of the situation in it as respects hours. Opportunity will be taken to sum up briefly the conclusions regarding the working of the three-shift system, which were reached in the earlier investigations of the subject; and to add a few statements which will bring down to date the important phases of the evidence there presented.

The Old Basis—a Two-shift Day.

For almost a generation, a few minor branches of iron and steel making have been operated on three shifts, or an approximate equivalent. This has been true of the making of wrought iron and of what are known as "hot mills" in sheet

¹ See "The three-shift system in the steel industry," a paper read by the writer before a joint meeting of the Taylor Society, the Metropolitan and Management Sections of the American Society of Mechanical Engineers, and the New York Section of the American Institute of Electrical Engineers, in New York, December 3, 1920, and published in the February, 1921, issue of the *Bulletin of the Taylor Society*. A more analytical study by the same writer entitled "The Technique of Changing from the Two-shift to the Three-shift System in the Steel Industry" was prepared for the Cabot Fund, and a small edition privately distributed in May, 1922. This has not yet been released for general publication. See also Mr. Bradley Stoughton's report on steel in Part III of this volume.

mills. Here and there a few specially difficult jobs have been on eight hours; and once in a great while, an entire department. But these places where custom has long established an eight-hour shift occupy a small place in the steel industry as a whole. Prior to the War, the major branches of the steel industry were, practically without exception, operated on a two-shift basis. About one-half, or a little less than one-half, of the employees in the continuous-plants were on day-work, which was usually ten hours. The other half (or more) of the employees worked twelve hours, or an alternation of eleven hours one week and thirteen the next (or ten hours one week and fourteen the next). In 1919, the United States Steel Corporation gave the number of its twelve-hour employees as between 69,000 and 70,000 and the number in the entire industry probably ran as high as 150,000.

Formerly, steel plants were also on a seven-day week. But beginning about a dozen years ago, efforts have been made to reduce the volume of seven-day work. Seven-day work is almost entirely extinct in rolling mills and to a large degree is absent in open-hearth and Bessemer work (though when business is normal a considerable proportion of the "Independents" still operate their open-hearth furnaces a full seven days). By-product coke ovens and blast-furnaces must, however, run seven days a week. In these branches of the industry the Steel Corporation and some of the "independents" have adopted arrangements by which the individual men are relieved one day in the week. Others among the "independents" still employ the men in these departments a full seven days a week.

At one time it was thought that the steel industry could not be operated on any other basis than two shifts. Later, any tendency towards shortening hours was counteracted by the introduction of labor-saving machinery; which has gone so far in the steel industry as practically to remove the strain

from the majority of jobs. Furthermore, such work as is left is generally intermittent, so that, in most cases, the twelve-hour steel worker does not actually work more than six or seven hours. Combined with these conditions, which seem to make a twelve-hour shift feasible from the physical standpoint, there were many, especially among the foreign-born steel workers, who were willing and eager to work for as long as twelve hours, provided that by so doing they could earn slightly more money. Finally, the tendency towards ten or eleven hours for the day shift, and thirteen or fourteen for the night shift, represented a crude approach to a ten-hour day, for on the long night shifts there was usually a certain amount of sleeping. All of these considerations together somewhat mitigate—but they are not a satisfactory solution of—the fact that an average daily employment of twelve hours, added to the hour or so lost in coming and going, keeps a man away from his family or his other outside interests too large a portion of his waking hours.

Tendencies Toward Shorter Shifts.

During the War, there was some tendency towards three shifts in the steel industry, in harmony with the larger movement in this direction which was taking place outside. But the movement did not reach very large proportions, partly because there was in the industry an acute shortage of labor, and in steel towns a shortage of houses, which made the large companies hesitate to attempt to put on an extra shift. By the end of 1920, about twenty of the "independent" steel plants—some large, but more of them small—had changed to three shifts—a number impressive enough to deserve some attention, but not large enough to affect very greatly the proportion of twelve-hour work in the industry. Thus as late as the beginning of the present period of depression, the steel industry

was apparently almost as fully on a two-shift basis as it had ever been.

There is, however, reason for believing that a changed attitude had been developing, influenced by:

1. The general pressure throughout the country towards shorter hours.
2. The steel strike of 1919.
3. The attacks on the twelve-hour day in Congress.
4. The Interchurch Report on the steel industry.
5. The conviction on the part of many steel men that the twelve-hour day is too long a period for men to work.

Position of U. S. Steel Corporation.

The Steel Corporation had appointed a committee empowered to consider and report on the practicability of abolishing the twelve-hour day. As the pressure for production and the shortage of labor in the steel industry subsided in the fall and winter of 1920-1921, the work of this committee became more active. A number of statements were issued regarding the progress of the committee's work; and finally, in the spring of 1921, Judge Gary issued for the Corporation a statement to the effect that the Corporation hoped to be able to eliminate the twelve-hour day, as the difficulties of doing so were overcome.

There is reason for believing that the officers of the Steel Corporation regarded the statement cited as a definite declaration of policy on the part of the Corporation, that they intended to be understood as announcing a program of abolishing the twelve-hour day in Corporation plants within the course of a year or so. But the statement was embodied in explanations as to the difficulties in the way of abandoning twelve hours. It came at a time when throughout the coun-

try there was a tendency towards lengthening rather than shortening hours. The Steel Corporation's proposed course met the moral opposition of some of the "independent" steel manufacturers. The investigator found during his studies in 1921 that there was a prevalent impression abroad both among the "independent" producers and the outside public, that the matter of abolishing the twelve-hour day in the plants of the Steel Corporation had been allowed to drop.

Without calling into question the sincerity of the Corporation's intention of eventually eliminating twelve-hour work, there can be no question but that, by the time the Corporation had issued its statement, conditions were rapidly becoming less favorable for changing to three shifts. A moderate slackening in business activity would have been favorable to introducing a third shift; but the depression which came on the steel industry was so severe that, while it interposed no mechanical obstacle to going to three shifts, it yet had the effect of turning people's thoughts in quite other directions. There were times in the summer of 1921 when steel production fell to as low as, or lower than 30 per cent. of normal. The average hourly earnings of twelve-hour men, taking into account the abolition of overtime, were reduced about one-half. Costs were high, compared with selling prices; unemployment was very large.

Under these conditions the question of reorganizing the system of shifts in the steel industry was perhaps not unnaturally put in the background, while thought was turned on problems which were for the moment more grave. Moreover, men hesitated to put into effect a reduction of hours by one-third, when wages had just gone down by one-half; or to talk of making changes which might increase cost, when cost was already above selling price. What enthusiasm could be aroused for getting out more output, when, in some of the plants, at least, the greater the output the greater the losses,

or for reducing the labor force when it meant discharging key men, whom it was desired to keep on the pay roll? Why shorten hours when men were fortunate if they had employment one week out of two? It is not surprising, considering the many harassing circumstances, that for some months practically no thought was given to making any far-reaching changes in the shift system.³

Conditions in 1921.

There was no reason, however, why shifts could not in many cases be shortened during 1921, even if the development of a permanent three-shift system had to come later. In fact, the very depression and accompanying unemployment were the strongest of reasons why work should, wherever practicable, be divided among as large a number of men as possible through shortening the hours worked by individual workers. And this course, was, in fact, followed to a large extent. The movement, however, had its drawbacks and limitations. In some cases, the older and more valuable employees, whose incomes had already been radically affected by cuts in the hourly rates and perhaps by temporary transfer to positions below their regular grade, were unwilling to have hours reduced, in order to give work to men who belonged to the less stable element of workers. There is some risk in a company's going too far in giving all employees a small amount of work, as competitors may coax away the pick of the employees by offering full-time employment. This general situation was the cause of some oscillation between twelve-hour and eight-hour shifts.

³Late in 1920 and early in 1921, both external conditions and sentiment in the Steel Corporation and among many of the "Independents" were favorable for changing from a two-shift to a three-shift basis. Some of the "Independents," believing that the Corporation was about to make such a change, had their new manning scales ready. But before the Corporation could officially make up its mind, conditions had changed so that the situation became unfavorable in the respects just enumerated.

Notwithstanding the circumstances just discussed, the proportion of twelve-hour work in the steel industry was materially reduced during 1921. Most of the reduction in hours was by way of putting what had been on two twelve-hour shifts on two ten-hour shifts, or by having as much of the work as possible done by day-workers. Thus the Steel Corporation ran rolling mills on ten-hour shifts. All sorts of arrangements, as twelve-, ten-, nine-, eight-, and even six-hour periods, were introduced. Men were also worked a week and laid off a week. The net result was a substantial reduction in the amount of twelve-hour work. At times the proportion of twelve-hour workers in plants would be only 10 or 15 per cent., whereas formerly the common proportion was 50 or more per cent. The tendency was to retain on twelve-hour shifts only such work as absolutely had to be continuous through the twenty-four hours.

While some of these innovations of 1921 could be maintained as a part of permanent shift policy, yet it is evident that much of the development was essentially temporary. When the steel industry fully recovers, it is doubtful if large plants will want to run their rolling mills only twenty hours out of the twenty-four. Nor did the steel mills in 1921 do much to lessen the proportion of twelve-hour work on blast-furnaces, open-hearth furnaces, or other continuous-process work. In the absence of some firmer policy than was followed in 1921, there would likely be a drifting back towards the twelve-hour day in the steel industry as times improve.

Present Situation and Outlook.

At the date of writing, September, 1922, the indications are that the steel industry plans to go forward rather than back. Addressing the annual stockholders' meeting of the Steel Corporation on April 17, 1922, Judge Gary announced: "Between October, 1920, and March, 1922, we reduced the

twelve-hour men from thirty-two per cent. of the workmen to fourteen per cent." * On May 18, 1922, President Harding entertained forty or fifty of the country's leading steel men at a White House dinner, and on this occasion suggested to them the importance of the steel industry's giving attention to the problem of eliminating twelve-hour work before business should have returned to its full volume. Following this dinner, Judge Gary, as President of the American Iron and Steel Institute, appointed a committee to investigate the practicability of the steel industry as a whole abolishing the twelve-hour day. This important change, though under serious consideration, is, however, yet to be made.

Hence the whole question as to the relative advantages of the two-shift and three-shift systems in the steel industry—the question of relative efficiency, relative cost, and relative satisfaction—is of as vital importance now as it has ever been in the past.

In view of what has been published elsewhere we will not undertake for the steel industry a detailed presentation of evidence regarding the results which have been realized in such plants as have gone to three shifts. It is opportune to recall, however, that when the three-shift steel plants were studied in 1920, most of the plants reported that it cost somewhat more to operate on three shifts. However, in almost all cases, the managements stated that, considering the intangible as well as the tangible factors, they were better satisfied with three-shift than with two-shift operation. While one of the larger of the three-shift plants mentioned in the 1920 report⁴ went back to two shifts at the beginning of 1921 (as was noted in the paper as published), stating that the arrange-

* Presumably these statistics, like those given out by Judge Gary on previous occasions, are for the proportion of twelve-hour men among all the employees of the Corporation, including those in coal mines, on railroads, etc. If so, the percentage of twelve-hour men in the steel plants proper would be considerably greater than the figures show.

⁴The Inland Steel Co.

ment had not worked well, such of the other three-shift plants as the writer has been in touch with have remained on three shifts.

In fact, the evidence, after a year of depression, is now rather more favorable to three-shift operation than it was in 1920. This would seem to be the case partly because, down to the close of 1920, conditions were not favorable for getting the greater efficiency which might be expected on shorter hours, and partly because with two years' additional experience managements now have both more skill, and more confidence in the change.

Thus not far removed from the company which in 1921 returned to two shifts, another plant, engaged in all the stages of steel manufacturing from blast-furnace to rolling mills, had reported in 1920 that its labor costs were almost, but not quite, as low on three-shift as on two-shift operation. The approximation to costs as low as they had been on two shifts was, however, only for a brief period, too brief, in fact, to make it the basis of a definite statement of findings. Just when there was reason to hope that by satisfactory costs maintained during a six months' period, it could be shown that the three-shift system had justified itself financially, the severe depression began, and for some time there was not business enough to do much three-shift operation, nor were costs comparable with what they had ever been before. But this company did not abandon the three-shift basis as a principle, and intends to continue with three shifts as business returns to normal.

Another prominent steel company⁵ which followed a policy of paying as much for eight as for twelve hours,⁶ was

⁵ The American Rolling Mill Company.

⁶ Including bonus. The company set up a minimum wage per eight-hour shift for each job which was eleven-fourteenths of the earnings on the same job on a twelve-hour basis. To this was added a bonus arrangement by which the men could make as much on the eight-hour shift as they had on the twelve-hour shift, through increase in production.

cited in the 1920 report as coming out almost even. But at that time the company was reluctant to pronounce its three-shift system a permanent success until it had withstood depression as well as prosperity. In the fall of 1921, this company reported that in its producing departments—open-hearth and rolling mills—nothing would be gained by going back to two shifts. In the service departments expenses would be cut to some extent if the company were willing to go back to two shifts, but as to the amount of the loss which three-shift operation meant in these departments, the company was not certain. They did not intend, however, to go back to two shifts.

Another three-shift company,⁷ whose plant ranks among the largest and most diversified in the steel industry, and whose employees originally petitioned for and accepted three shifts on a basis of no higher earnings per hour than were paid in two-shift plants, reported in 1920 that its manning had increased 50 per cent. In January, 1922, this company gave the increase as 35 to 50 per cent. ;⁸ and, after reiterating its feeling of satisfaction with the working of three shifts added: "We are strongly opposed to twelve-hour working shifts, though not opposed to a ten-hour day where conditions seem to make that desirable. We believe that industry in this country can be so conducted as to permit of eight-hour shifts in continuous operations." The company believes that some of the stronger-bodied European laborers have sought employment in the East where they can work twelve hours and, therefore, earn more pay. This, however, has not pre-

⁷ The Colorado Fuel and Iron Company.

⁸ The investigator was unable to determine by correspondence whether this represented a definite improvement due to the passage of time, or whether it was mainly a difference in the way of putting the figure, the latter estimate being the more carefully made. Owing, indeed, to many changes in operating conditions, the company reported that it would be difficult, if not impossible, to make a perfect comparison.

vented the company from being "strongly in favor of the eight-hour shift."

The evidence collected in 1920 and a weighing of the experience of 1921 and 1922 would indicate that it is doubtful whether all the departments of a steel plant can be operated as cheaply on three shifts as on two shifts, if the men receive as much pay for eight hours as for twelve. But there is tangible evidence, strengthened by the developments of the last year, which indicates that under active and able management and with reasonable cooperation on the part of labor, costs on the three-shift system can be kept as low as on the two-shift system, provided wage-rates are compromised so that eight-hour men receive pay equivalent to ten hours' instead of twelve hours' pay. Such a compromise, or even one less liberal, is ordinarily satisfactory to the men.

At the same time care should be taken not to be overconfident. Most managements do not give the attention which they might give to the matter of securing the highest attainable degree of labor efficiency; so that it is probable that, in case of a general change from two to three shifts in the steel industry, assuming a fifty-fifty compromise on daily wages, the greater proportion of the plants would, for the time being at least, note some increase in labor cost. But, as shown in the special reports on steel referred to above, this increase in cost could not be large; and there is no reason why it should not be practically offset by intangible improvements in relations and operations, due to the plant's being on a more satisfying day.

It is very significant that, during the late period of very acute depression, exceedingly few companies, either in the steel industry or in other industries, have seen fit to go back from eight-hour to twelve-hour shifts.

THE NON-FERROUS METALS

One of the outstanding facts developed by the present investigation has been the variety and apparent contradiction in the shift arrangements followed in the different continuous-industries or in separate sections of the same industry. For instance, the steel industry has continued to operate largely on the two-shift system whereas in all the non-ferrous metal industries the eight-hour shift became general long ago and is now practically universal.

The processes in smelting and refining ferrous and non-ferrous metals are essentially similar. The equipment in the way of furnaces, converters, and rolling mills is often quite analogous. Labor-saving equipment, indeed, has been introduced more generally and on a larger scale in the steel industry than is true of the non-ferrous smelting and refining plants, thus lightening human labor to a degree which makes the eight-hour shift less necessary. Fumes or other undesirable working conditions may sometimes argue for the shorter work period more strongly in the non-ferrous than in the ferrous plants. But these reasons are inadequate to account for the profound difference in practice. The reason does not lie in the nature of the industries or of the work, but in the attitude of employers and employees.

The three-shift system in the metal industries is a western development. Originally the western smelters were on twelve-hour shifts. But all inquiries which have been made of mining and refining companies regarding present practice have been met with the same reply, that all the non-ferrous metal plants in the West of which the companies have knowledge are on three shifts, the change usually having been made twenty or thirty years ago.⁹ Important factors in bringing

⁹ E. E. Thum, Associate Editor of Chemical and Metallurgical Engineering, wrote to the *New York Times* under date of March 9, 1921 as follows:

“I would call your attention to the fact that in copper and lead

about this development have been the greater strength of the unions in the West and the stronger sentiment there in favor of shorter hours.

Although the evidence collected indicates that three shifts long ago became the rule in the non-ferrous metal industries of the West, yet the outbreak of the War found various copper, zinc, and nickel plants in the East and South still operating two twelve-hour shifts. The abolition of the twelve-hour day in the non-ferrous metal industries of the East and South was a development of the War; but it has been so complete that extended inquiry has failed to reveal any important non-ferrous metal plant in any part of the country which is not at the present time on three shifts. The only satisfactory explanation for the difference between the course of the steel industry and the non-ferrous metal industries in the East and South would seem to lie in the greater mass of the steel industry, which made it react more slowly to the sudden external pressure which accompanied the War, and also made it present a larger problem quantitatively, particularly in a period of labor shortage.

Though the investigation failed to disclose any important non-ferrous metal plant which is on two shifts, in some less important places some twelve-hour work has been found. Two shifts are still the practice in some of the later-stage processes in the lead industry; and in the case of certain

smelters the eight-hour shift is very common, and has been for many years. The exact date when the change from the twelve-hour shift to the eight-hour shift in the western smelters occurred the writer cannot definitely state. However, he entered the employ of the Anaconda Copper Mining Company early after the completion of their Washoe Smelter in Anaconda—a plant which rivals many of the Steel Corporation's plants in size and number of employees—that is to say, nearly twenty years ago. Men at that plant have always worked on the three-shift plan, 7 to 3, 3 to 11, 11 to 7. Since that time I have traveled rather extensively in the United States, and believe I have visited every lead or copper smelter west of the Mississippi River, and in none of these plants was a twelve-hour shift in effect. All of them naturally operate furnaces which are in blast continuously from the year's beginning to its end."

auxiliary jobs in the making of aluminum. The twelve-hour shift was also found in two small Philadelphia plants which prepare miscellaneous metals and alloys, using scrap or new metal. A more exhaustive analysis might show other odd places in which twelve-hour jobs are to be found. But in few instances, if any, are twelve-hour shifts to be found in the primary smelting, refining, or rolling processes of non-ferrous metal plants.

Copper.

No copper or other non-ferrous metal plants located west of the Mississippi River were visited, in view of the long time which has elapsed since their change from two to three shifts, but several persons active in the management of such plants were consulted in the East. A representative of the Anaconda Copper Company was of the opinion that their smelter had been on eight-hour shifts for twenty-years—he was of the opinion, indeed, that they had never been on twelve-hour shifts. In the western plants of the American Smelting and Refining Company the twelve-hour shift was abandoned something like twenty years ago and now day-workers as well as shift-workers are on eight hours.

For the most part, the details of what happened in western copper and other non-ferrous metal plants twenty years ago when the three-shift system was established have passed from memory. Records are not to be found.

A much more complete, trustworthy and recent conception of the meaning of the change from two to three shifts in the metal industries can be obtained by noting the experience of plants in the East or South. Some of the eastern plants went to three shifts under unusual war conditions, which introduced abnormal factors into the transition. But the Tennessee Copper Company changed from twelve-hour to eight-hour shifts at a time when conditions were nearer nor-

mal than at almost any other time in recent years, namely, in February, 1919.

The Tennessee Copper Company has mines and a smelter at Copper Hill, Tennessee. The copper ore in this locality is rich in sulphur, so that a large sulphuric acid plant has been built to make acid out of the smelter fumes. Acid plant, smelter, and auxiliaries together require about five hundred and sixty employees. All employees are white.

The change to three shifts was made largely because the company at that time adopted a policy of recognizing and bargaining with the union, and the union was strong for eight hours. The agreement made with the unions at the time of reducing hours did not call for any increase in hourly wage rates. In fact, there was some actual saving to the company in this respect because of the cutting out of overtime work. But wages were fixed by a sliding scale agreement which did cause the rates to rise later on in 1919. Whereas prior to February 1, the pay for common labor was four dollars and twenty cents for a twelve-hour day (thirty cents an hour straight time, forty-five cents an hour overtime—average for the twelve hours, thirty-five cents) and immediately after February 1, two dollars and forty cents for an eight-hour day (thirty cents an hour) in time, the pay rose to three dollars and forty-eight cents for an eight-hour day. Later on wages again dropped. At the beginning of 1922 they stood at two dollars and forty-eight cents for an eight-hour day, or thirty-one cents an hour. However, at many times the company has voluntarily kept wages above the level to which they would have fallen under the sliding scale. The rate of thirty-one cents in 1922 was about 29 per cent. higher than the standard for twelve-hour work in the South, and higher by much more than 29 per cent. than the rate paid in many plants. So on the wage question it may be said that the men in this plant sought and accepted the eight-hour shift at a

sacrifice of more than one-third of their earnings, but that the company, when prices and wages generally went to lower levels, saw to it that the hourly rates were maintained at a somewhat higher level than would probably have been the case had the two-shift system been retained. This wage differential was, however, nearer 25 or 30 than 50 per cent.

Whatever burden may have arisen in the matter of wage-rates was, however, more than off-set by increased efficiency. Immediately after the displacement of twelve-hour by eight-hour shifts, efficiency improved. It kept on improving; indeed, some of the most substantial improvements came in 1921, more than two years after the change. Gain in efficiency came through several channels. A great many jobs were consolidated, so that a man was able to do his own work and that of others. Thus where two men had been serving two acid towers a bridge would be built between the two and one man would serve both. Or perhaps three jobs would be combined to form two, new wage-rates appropriate to the heavier responsibility being established. Coupled with the reduction in manning there has also been an increase in the tonnage obtained from the equipment, as respects both copper and acid.

As illustration of the tangible character of the gains in efficiency, an output of 30.49 tons of ore per man daily during January, 1921, was increased to 35.42 tons of ore per man daily in September, an increase of 16 per cent. These, of course, are only the more recent of the gains which have followed upon shorter hours. Long run figures might reflect better the improvement in its entirety, but at the same time would be more apt to be influenced by disturbing factors. It may be noted, however, that a comparison of production as it was in 1913—prior to the War—under the two-shift system, with production in 1921 under the three-shift system, showed an increase of 28.8 per cent. in the tons of ore smelted per

man—this in spite of a reduction in the hours of smelter and acid employees from twelve to eight, and of miners (whom the figures include) from nine-and-a-half to eight.

The officers of the company recognize that a change to three shifts made a year or two earlier than February, 1919, might not have found the men disposed to do so much better. But, while the termination of the war period may have been a more or less necessary condition to securing greater efficiency, this is to be regarded only as the removal of a hindrance, and not as in itself the cause of the heightened efficiency. It is also to be noted that the increased efficiency came mostly in connection with new plans for manning worked out by the management, and was aided by a general improvement in the relations between management and men due to efforts made along various lines by the company. But it was primarily because the men were on an eight-hour and not a twelve-hour shift that the management felt justified in tightening up on discipline, and was able to succeed with drastic cuts in the number of employees. And the shortening of hours was the central factor in the improved relations and spirit which led to the men's better response.

This complexity of cause and effect, of course, makes it difficult, if not impossible, to find any precise statistical formula for the effect on efficiency and cost of going from two to three shifts. But the investigation showed that all the heads of departments at Copper Hill were agreed that the change to an eight-hour shift had been of benefit to the company. Men who had opposed such an arrangement had, after three years of trial, become enthusiastic.

The officers in charge of personnel report that the men are much better satisfied than formerly: The company has been trying to work in cooperation with the union and has also established machinery for receiving and handling grievances. But since the shortening of hours operation has proceeded

with so little friction that the grievance committee has practically ceased to function. The company is in the peculiar position of having recognized and supported rather than antagonized the development and functioning of the union, only to find that the union membership has been falling off, due to the lessening of the irritations which had existed while hours were long, and the disinclination of the men under these circumstances to pay their dues. Furthermore the men work more regularly than while on the twelve-hour shift. The company has not noted any change in the accident rate which could be attributed to the change. All employees, day-workers and shift-workers, are on eight hours, the shift-workers constituting about 45 per cent. of the total force (mines not counted).

Zinc.

At Palmerton, Pa., is located the main plant of the New Jersey Zinc Company, producing smelter, zinc oxide, and lithopone and also operating two regulation blast furnaces for the manufacture of spiegel iron. The plant is, in fact, a steel as well as a zinc plant. From 60 to 70 per cent. of the employees are on shift-work, the chief day-work being construction, repair-work, and shop-work.

The Palmerton works changed from two to three shifts about 1915. In making the change to three shifts the company endeavored not to increase the number of men. This aim they approximated but did not fully reach.

The main product of the Palmerton plant is zinc oxide. On the twelve-hour shift, a man pulled six fires per shift. On the eight-hour shift the number was eight fires per shift. Thus, as regards this particular operation, the men accomplished more in eight than in twelve hours. The work on the twelve-hour shift had, however, been heavier than it is on the eight-hour shift, because the furnaces formerly had to

be charged from the floor. Under the present arrangement there is a saving in the labor of shoveling.

The production of spelter had, under the two-shift system, been a twenty-four-hour job. The daily campaign in this department is still twenty-four hours long; but the work is divided between two gangs of men who do not wait for relief. One set of men comes on at 5 A. M. with certain work to do, for which they are paid so much. When they get through they go. This may be at the end of four hours, or it may take six or seven hours. Later on the other set of men do the drawing. In this department the company was able to make the desired reduction in hours without increasing the force, through the arrangement described.

The blast furnaces were an exception. These were changed to three shifts about a year later than the rest of the plant. In a few cases it was possible to arrange the manning so that one man could serve both stacks; but, on the whole, there was little saving in manning of the blast furnaces. The men now have about an hour-and-a-half of free time between casts. But the company believes that, even under the eight-hour shift, the men should have that much rest.

The zinc rolling mills, which started in 1917, were never on twelve-hour shifts. In 1920, they were on three eight-hour shifts. In 1921, owing to slack business, they ran only one nine-hour shift.

The experience at Palmerton throws some light on the question as to what is apt to be the final relation between wage-rates in twelve- and eight-hour plants after a series of wage advances and wage declines have made out-of-date the special adjustment in wages made at the time of changing hours. At the time of going to three shifts, the New Jersey Zinc Company made a liberal adjustment of wage-rates, thus lessening the financial burden which would have had to be borne by the men because of going to shorter hours. However, six

years of ups and downs in the general labor market resulted by 1921 in wages in this eight-hour plant being thirty-two cents an hour for men newly taken on, as against twenty-seven cents an hour for the twelve-hour work at Bethlehem, and thirty cents an hour for twelve-hour work at Pittsburgh. Thus at the time of making the comparison, these other Pennsylvania plants, by maintaining a twelve-hour day, were getting men to work only from two to five cents an hour cheaper than the rate which was paid men who worked eight hours. It will be observed that the efficiency in the eight-hour shift plant had been increased in a ratio much larger than this wage differential.

The management at Palmerton is of the opinion that the costs are lower under the eight-hour shift system than they were under the two-shift system. They think it possible that during the depression of 1921 they might have been able to put their men back on two shifts and reduce hourly wage-rates. But this would have been only because of the unusual conditions then existing. Taking a ten-year period, they think the three-shift system would be more profitable than the two-shift system.

The day-work at Palmerton was reduced from ten to nine hours.

At Palmerton, as well as elsewhere in the zinc industry, there is a peculiar variation of the three-shift system, probably imported from abroad. In one department, there are three sets of men working six-hour shifts each. Each gang is on six hours, off twelve hours, and on six hours. Thus the men come to work six hours earlier each day, and in four days have accomplished a complete rotation. The total number of hours worked in the week is, of course, the same as though they had worked eight-hour shifts.

Lead.

Most of the lead produced in the United States is turned into white lead (oxidized) and used in paint. The smelting of lead and the oxidizing of lead is carried on in separate plants, thus dividing the industry into two branches.

The principal producer of white lead reports that in lead-smelting three shifts have prevailed for many years.

But this is not true of the oxidizing plants. The great bulk of the employees in an oxidizing plant are on day-work only. In the department where the oxidation actually takes place the operation is continuous; and such shift-workers as the company employs are on two twelve-hour shifts, except at the Pittsburgh plant, where they are on three shifts, but the number of shift-workers is small. The whole of the oxidizing department requires only a small proportion of the total force; and most of the actual work in this department, such as the emptying of the stacks, is done by day-workers. Only the work of tending the furnaces—requiring altogether about half the employees in this one department—is on twelve-hour shifts.

Nickel.

The International Nickel Company put its Bayonne plant on three shifts in October, 1915, late enough to have the war labor situation to contend with at the start, or shortly afterwards. They were able to make some savings in the number of men required per shift. Also there was some gain in output. As the equipment is only supposed to turn out so much product, it might be supposed that it could make no difference in output whether the men worked twelve hours or eight. But sometimes there are breakdowns or other sources of trouble, and it has been found that, especially in hot weather, production is started again more quickly after an

interruption when the men are on eight-hour shifts. The management states that the increased efficiency of the men due to going to three shifts is approximately 20 per cent. This helped to counterbalance the increase in pay-roll expense, which was 50 per cent. The eight-hour men were given the same amount of money they had formerly received for twelve hours.

In addition to the tangible gains in efficiency represented by the 20 per cent., there were many intangible benefits derived from the shortening of hours. For instance, the company had previously made a practice of shutting down during July and August. Supposedly this was for repairs; but the real reason was that the men would not work during the hot months. But since the establishment of the three-shift system the company has operated throughout the year. There has been also tightening up of discipline. An especially bad feature of the old system was the twenty-four hour turn, which came when shifts were rotated. For a couple of days after they had worked these hours, the men were not up to their usual standard of performance. The three-shift system eliminated this feature.

Considering the intangible factors, the company is well satisfied with the outcome of three-shift operation. The management thinks that it is important to get away from the twelve-hour shift on work which must go on seven days a week. In any place where the work is at all heavy the management would not consider two-shift operation. In 1921, because of slackness and demoralization of production, the company did not run on its regular schedule, and there was some reversion to longer hours. But this was only temporary. The management believes in the ten-hour day for day-workers.

In Canada, where the International Nickel Company has more employees than in the United States, the results of

going to three shifts were better than at Bayonne. This was largely because operations were not affected so much by the war labor situation. It happened that the employees in Canada were Austrians; and of course, under the circumstances of the War, the Austrians were not so free to move about as were the American employees. It may be noted that when the Canadian plant was first put on three shifts, the other plants in the district were all on two shifts. Now all have gone to three shifts.

The operating head thought that during the depression of 1921 it might have been possible to compel a return to two shifts as the men could have been induced to do anything. But in normal times he did not think it could be done. Sometimes it is hard to get men who have always worked on a twelve-hour shift (this company had formerly had an alternation of ten- and fourteen-hour shifts) to think of anything but the money which would be sacrificed in changing to a shorter day. But when once accustomed to the shorter shift they could not be persuaded to return to the longer one.

At one time the International Nickel Company had a plan by which the men on each group of furnaces had one day off in the week; their places being taken in rotation by a force of experienced men who were able to handle the jobs on the various furnaces, and who themselves had Sunday off. This plan gave the men a forty-eight-hour week. It worked well, and both the men and the company liked it. However, following a strike, and the subsequent infusion into the force of many inexperienced men, the plan was given up and has not been resumed.

The management of this company believes that accidents are less frequent under the three-shift plan.

Aluminum.

The Aluminum Company of America adopted three-shift operation in the "nineties," while their works were still concentrated at New Kensington, near Pittsburgh. Each new plant has been operated on the three-shift basis. A very small portion of the employees at each plant are on a twelve-hour basis, but this is confined to engineers, stokers (where work is automatic) and watchmen.

The production of metallic aluminum involves what is necessarily a continuous process, and the majority of the employees are on three shifts per day, which do not rotate unless the men themselves so desire it. Ordinarily there is a permanent day, and two permanent night, gangs. However, where the men request rotation, this is arranged for, either weekly, or bi-weekly, by reducing to eight hours the time off between shifts, one shift having thirty-two hours off.

In the rolling and fabricating of aluminum, the work is not strictly continuous. Of the 3,000 men employed at the New Kensington works, approximately two-thirds work on two ten-hour shifts and one-third are on day-work entirely.

Inasmuch as it was more than twenty years ago, and in the infancy of the company, that three shifts (on most of the work) were substituted for two shifts, it is not possible to make any very definite comparison between the results of the two methods of operation. The company is of the opinion that the work is so lacking in real physical strain, consisting, for instance, of such work as watching gauges, that there would be nothing physically impossible in the men working twelve hours. The obstacle to twelve-hour shifts would be the general sentiment against it and the difficulty of getting the men to go on such a basis; nor would the company itself want to go back—barring foreign competition on such a basis as would compel it.

So far as day-work is concerned, and wherever it is possible so to arrange it on shift-work, the company believes in the ten-hour day.. It is the conviction of the executives that, while, at the time of going from ten to eight hours, men might do as much in eight as in ten hours, after a number of years it would be found that they had dropped back to the old standard rate per hour.

CHAPTER VII

GLASS AND CEMENT

GLASS

THE making of glass and glass products may be regarded either as a single industry or as a group of industries. All glass is alike, in that it is made from raw ingredients of certain kinds melted in pots or tanks and later annealed. But it will be found that the difference in the processes by which the various glass products are given their final form are often of the most fundamental character.

Furnaces, Pots and Tanks

In every glass works is to be found a furnace with its pots or continuous tanks. Whether pots or tanks are used, the firing and the supervision of the melting is a twenty-four-hour procedure. It is well to keep the continuous nature of the furnace work in glass plants in mind, because it is here that the problem of the twelve-hour shift is mainly to be found. We shall find that in some branches of glass working, long hours have perhaps never existed, and that in others they have been nearly eliminated within the last few years. But until quite recently, the twelve-hour shift was the rule for men employed in either a supervisory or laboring capacity about glass furnaces; and the practice is still a common one, even where almost all other employees, especially those working on shifts, are on a day of about eight hours.

The number of furnace men in a glass plant is usually small. If in addition to the men about the furnaces those

employed on the annealing ovens or leers are on twelve-hour shifts, then the total of twelve-hour employees may constitute a considerable group. But there are glass plants (with furnaces on two shifts) where, at any one time, not more than one or two men would be working on the twelve-hour basis. Compared with much of the other work about a glass plant, a furnace man may have a good deal of waiting to do. But there will be times when the work is hot.

The operator of a glass tank is called a shearer in the East, and in the West a teaser. In the case of large tanks he will have other men as helpers. There is a difference of opinion in the glass industry as to whether it is sound practice to have the teaser on eight-hour shifts. The proportion of such men is not large enough to make much difference in the pay roll. But it is held by some manufacturers that better results come from having two, rather than three, different men responsible for the melt. Other glass manufacturers, however, do not hold this opinion. Only a few miles from the spot where a bottle manufacturer, who had put his teasers on three shifts, said it did not work so well, a manufacturer of chemical glass, who had made the same change, said it offered no handicap. Many other glass manufacturers consulted have taken the position that there is no technical obstacle in the way of having three teasers on the job. This is especially the case where the use of pyrometers and a definite system of instructions and inspection has so strengthened the technical control over the process that the real responsibility is no longer in the hands of the two or three men who take turns on the furnace,—the work being planned and controlled by the technical staff.

Under modern operation and supervision, not much real difficulty is ordinarily to be expected in detailing three, instead of two, men to have charge of the glass furnace or tank. It is possible that in some special branches of glass manufac-

ture, where the process still depends upon individual knack and skill, and has not been thoroughly reduced to formula, it may simplify matters if one man does duty for twelve hours, rather than have a supervision which changes every eight hours. But at most, the area in which it may possibly be more satisfactory to have long shifts—whether because of the special character of the glass, or because of the type of management employed—is small; and with improvement in technical knowledge and control is certain to diminish. Even at present there is nowhere an absolute bar to going to three shifts.

Most branches of the glass industry are strongly unionized; but the unions have not included teasers or other furnace men. Within the last few years, some of the labor organizations have been trying to extend union rules to cover furnace men, and have succeeded in getting their hours reduced to eight. In other cases, such a change has been initiated by the employer. A large proportion of the furnace men engaged in the manufacture of flint glass, bottles, and window glass are still on twelve-hour shifts.

Flint Glass.

For convenience in classification there will be included under the head of *flint glass* all of the less specialized lines of glass manufacture, whether it be pressed ware, electric bulbs, chemical glass, or any of the innumerable small articles made of glass—in contradistinction to those more outstanding branches of the industry given over to the making of bottles, window glass, and plate glass. Aside from the melting of the glass, which necessarily requires that the furnace men serve through the night, this more general and miscellaneous section of the glass industry is not, in the majority of plants, operated absolutely continuously.

Taking the glass industry as a whole, continuous-operation

in the shaping of the product has been a matter of development, rather than something which inhered in the craft. Originally all glass was made in pots; and this is still the case in many types of glass manufacture. Under the pot system, the necessity for continuous-operation is not compelling. There is nothing to prevent such an arrangement of the firing of the pots, that all can be drawn at specified times of the day. Thus the actual working in glass can be confined within whatever hours may seem desirable. But with the introduction of the continuous tank the economy of drawing glass throughout the twenty-four hours becomes an important consideration.

The arrangement of working hours in the several branches of the glass industry may be said to have passed through the following stages of evolution:

1. The glass is made in pots and turned into finished products by hand by men working on one shift, or, more likely, on two shifts of from eight to eight-and-a-half hours each.
2. The introduction in a portion (but not all) of the plants of continuous tanks and automatic or semi-automatic machinery, has caused that portion of the industry to run through the twenty-four hours, most probably on twelve-hour shifts.
3. To meet the competition of the machine plants, the hand-workers agree to work on three eight-hour shifts, thus enabling their employers to get a larger output from their equipment, save in fuel, etc.
4. In the last few years the machine plants have been changing from two twelve-hour to three eight-hour shifts.

The flint glass industry is, for the most part, still in the

first of these four stages of development. A large part of the work is still hand-work. In the hand plants, one set of men work in the day-time two shifts of four hours or four-and-a-quarter hours each, making a day of eight, or eight-and-a-half hours. Another set of men work at night two shifts of four or four-and-a-quarter hours each, making a night shift of eight or eight-and-a-half hours. Thus the daily operating time is sixteen or seventeen hours. The employers are very eager to work continuously with three sets of men. It has been tried a few times in cases of emergency, and it was found that the employer who used his equipment twenty-four hours had an important advantage over competitors, in the matter of cost.

But the flint glass workers engaged on hand-work are thoroughly organized and are strongly opposed to putting on a third shift to run through the small hours of the morning. A force, however, which may eventually break down their resistance is the further adoption of automatic machinery.

The two eight-hour (or eight-and-one-half hour) shift system in hand-operated flint glass factories applies only to that major portion of the industry which is unionized. In the case of the Corning Glass Works, whose employees are not organized, the hand-workers were formerly employed on two ten-hour shifts. In August, 1921, those workers engaged in the manufacture of *pyrex* were changed from two ten-hour to three eight-hour shifts. The company reports that the change from ten-hour to eight-hour shifts resulted in:

1. Increased output per running hour.
2. A longer working week (for the plant).
3. Reduced overhead.
4. Better service.
5. Less absenteeism (excepting on the Sunday night shift).
6. Reduced labor turnover.

The two gains last mentioned were in part attributable to the change in general labor conditions. The chief difficulty in connection with the three-shift system was in obtaining punctuality, but the company states that this difficulty has tended to disappear and is outweighed by the advantages.

Machine work in the flint glass industry is to be found chiefly in the making of electric bulbs and tubing. Both in its mechanical and labor aspects, machine operation presents a different problem from hand operation, and the practice in the matter of hours and shifts has usually been different. At the Corning Glass Works, the bulb and tube machines were on two ten-hour shifts as long as pot furnaces were used. With the introduction of the continuous tank, about November, 1919, 30 per cent. of the blowing staff were put on continuous-operation on eight-hour shifts. In November, 1921, the proportion was increased to 85 per cent. The substitution of three eight-hour for two ten-hour shifts, besides permitting a longer furnace week, resulted in an increase in hourly machine output of 20 per cent. Except for this increase in production, the quality of the service rendered by the men was about the same. There was, however, an improvement in respect to absenteeism and labor turnover, partly due to a change in general labor conditions.

At the plant of another glass company, located at Toledo, it was found that the automatic machines were operating continuously, but on twelve-hour in place of eight-hour shifts. The hourly wage rates paid twelve-hour workers in this plant were the same as those paid by a competing plant in the same city, which operated on three eight-hour shifts.

In the plant last referred to, the work of finishing bulbs has recently been changed from day-work to continuous-operation on three eight-hour shifts. This change avoided storing partly completed bulbs and was found to be a distinct advantage.

Bottles.

The labor actually engaged in the hand blowing of bottles has never (so far as could be learned) been on a twelve-hour day. The old system was two shifts of eight-and-a-half hours each. It was the development of automatic machinery which influenced the bottle blowers' union, some ten years ago, to favor continuous-operation. Since then, the operation has been conducted on three eight-hour shifts, which, taking out a lunch-period, means about seven hours and a half of actual work.

Bottle-blowing machines are of two main types,—automatic and semi-automatic. Semi-automatic machines require hand gathering, and the arrangement of hours is the same as that followed in the blowing of bottles by hand. The automatic machines gather the glass from the tanks, as well as blow it into bottles, and do not require the same continuous activity on the part of attendants that characterizes hand or semi-automatic blowing.

The automatic machines were originally operated on two twelve-hour shifts but about 1915 or 1916, the leading company changed to three eight-hour shifts both on machines and tanks.

Window Glass.

All manufacturers of window glass, so far as is known, operate continuously, and predominantly on three shifts. But there is a considerable number of individual workers who are still on twelve-hour shifts.

At the largest window-glass factory in the United States, it was found that up to the time of the depression, all the tank men and a considerable number of others had been on twelve-hour shifts. Out of a total of 1,300 employees, some 175 were on twelve-hour shifts, about 354 on eight-hour shifts, and about 800 were on ten-hour day-work,

The twelve-hour employees included (on a single tank) the teasers, who have charge of the tank; two fillers (on each shift), who operate the charging machinery, reverse the drafts, and do whatever actual work may be necessary in connection with the running of the furnace; and two skimmers (on each shift), who remove clay from the surface of the glass. Also on twelve-hour shifts were the shove boys and leer tenders, who introduce and remove the glass from the leers.

The eight-hour employees included all the men in the blowing department—ladlers, ladle skimmers, blowers, cappers (who cut the cylinders transversely) and also the men who cut them longitudinally—as well as the flatteners.

Glass cutting, and much of the general work about the plant, such as that of machinists, electricians, and repair work of all sorts, is day-work.

This company on general principles favored three shifts, and expressed satisfaction with the results of eight-hour work periods and the belief that the men do not decline in efficiency through the day so much on eight-hour as on twelve-hour shifts. The company is tending towards the elimination of twelve-hour work. During the depression, teasers (but not the furnace men) were put on eight-hour shifts; and it was expected to continue this arrangement.

Ten or twelve years ago, the flatteners worked twelve-hour shifts. The company proposed going to eight-hour shifts so as to get more output per hour. The men agreed. The result was a material increase in the volume of flattening per hour; though less was done in an eight-hour period than in twelve hours. Flattening is very particular work; it is easy to spoil much glass through bad flattening. It is also hot work. There can be no question in the opinion of this management, but that from the production as well as the humanitarian standpoint the eight-hour shift is much preferable to

the twelve-hour shift for flattening. In fact this company would prefer six-hour shifts, which would give the maximum output per hour, though not per shift. Occasionally, as during the depression, the men who are on piece work will work on six-hour shifts.

The arrangements regarding hours described for this one plant are more or less typical of those prevailing in the cylinder-machine window glass industry. Some of the plants have gone a little farther in eliminating twelve-hour work; and, on the other hand it is possible that in some of the smaller companies the men operating blowing machines, or perhaps even the flatteners, may be on twelve hours.

In the hand window-glass plants, it is understood that the craftsmen work eight hours—actually seven-and-a-half—though when running short-handed they may sometimes work twelve hours.

In the manufacture of sheet glass, the Libbey-Owens Sheet Glass Company changed from two to three shifts about three years ago and at the same time established a bonus system. Distinctly better results were obtained. The bonus had something to do with the improvement, but the whole plan for better operations was dependent for its success upon getting away from twelve hours. All shift-workers, both tank men and machine men, were put on three shifts, but the cutters are on day-work.

Plate Glass.

The plate glass industry is unorganized. Aside from the original melting of the glass in pots, it is in its methods an entirely different industry from those which have been described as coming under the head of glass. Plate glass manufacture is an industry of large equipment and machinery, rather than of personal skill. The glass is cast from pots and rolled flat. It is passed through an annealing

leer, ground on revolving tables, and, after resetting, polished on similar tables. It is moved by overhead cranes; and on the whole the industry is more comparable to the steel industry than to the glass industry as usually conceived.

This industry was on two shifts until a few years ago. About five or six years ago the Pittsburgh Plate Glass Company, the largest producer, went to three shifts. According to the president of the company, the change has worked out satisfactorily.

About three years ago the "independent" producers of plate glass went to three shifts also. They were not quite unanimous in doing this; but the proportion of the plate glass industry still on two shifts is quite small—possibly not more than two or three plants.

The "independents" went to three shifts because at the time they did so the labor situation was such as to make it almost necessary, if they were to hold their labor. None of the plants visited had had any technical difficulty in going to three shifts. All regarded the change as right, but there was not much to report in the way of improvement in efficiency.

The factory manager of a Michigan plate glass plant visited did not see any difference in the number of men required per shift or in the production per hour on eight-hour as contrasted with twelve-hour shifts. But the eight-hour shift could not cost the company more than the twelve-hour shift, so long as there was no increase in the hourly wage rate. When this plant went to three shifts, the company paid the men just a little less than ten hours' pay for eight hours' work. But this advance was in lieu of an increase in wages which would have come any way.

The three-shift plan was adopted because the men kept pressing for it. The manager told them that it made no difference to the company whether they worked eight-hour

or twelve-hour shifts. (It would actually mean a little more bother to have three shifts of men, but that was a minor matter.) But it was a time when to secure men was difficult. The workers were told that if they were to go on eight hours they would have to find the extra crew. This they did, aided by the fact that men who had left the glass works because of the twelve-hour shift were now willing to come back.

After the change to three shifts, the more settled men began to acquire gardens or small farms. And since they were on an eight-hour day, they were able to take care of their acreage. In fact, the manager said that, by the help of their gardens, the men actually came out better financially than they would have come out had they continued to work twelve hours in the glass plant—for twelve hours' pay. And they were much more independent, in case the plant should be compelled to shut down or lay them off.

In the typical plate glass plant about one-third of the employees are shift men, the rest day-workers. In about half of the plants the making of the casts is on a single shift. In the other half of the plants this work is on two eight-hour shifts. In a few cases it might be on two twelve-hour shifts. In some plants the casts are made at a different hour each day, the process of making the melt and allowing the glass to cool before the cast taking a little over twenty-four hours.

However the casts may be arranged, the work on the glass after it comes out of the annealing lehr is continuous. The main reasons for running the grinding and polishing of plate glass continuously are the size and costliness of the machinery employed, the desire to get maximum output, and the convenience and economy of not having to stop.

In the making of plate glass, as is common in the other continuous-industries, the various mechanical and labor functions, as well as the cutting and shipping of the glass, are on day-work.

CEMENT

Next to the steel industry, cement is probably the most important continuous-industry which is still predominantly on two shifts.¹ But the industry is not entirely on two shifts. The two companies which, in 1920, turned out respectively the largest and the third largest output of cement are on three shifts in nearly all of their plants—one having been on this system for a number of years. Many of the smaller plants are also on three shifts, and a number are partly on three shifts, partly on two.

Report of Conservation Committee of Portland Cement Association.

For several years, the Portland Cement Association, which includes all but a negligible proportion of the cement companies, has had a Conservation Committee, whose main object has been to make researches for the whole industry regarding methods of increasing efficiency or reducing waste, mainly along engineering and material lines. The last year or two this committee has collected the most exhaustive and exact figures which have been found for any industry regarding the relationship between efficiency of production and the shift system in the various cement plants. In 1920, their survey covered eighty-six plants, or about 50 or 60 per cent. of all the cement plants in the country. Of these, fifty-one were on two shifts, thirteen partly on two and partly on three shifts, and twenty-two on three shifts. In the committee's full report, the eighty-six plants are classified and described in respect to size; as to whether they purchase or

¹ Cottonseed oil crushing, though employing fewer persons altogether, would probably have more men on shift-work—and certainly more men on twelve-hour shifts—than cement. However, the industry is seasonal. The brick industry has, of course, many more employees than the cement industry, but comparatively few are on continuous work.

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develop power; as to whether they use coal or oil in their kilns; the general characteristics of the process used; the per cent. of the year operated, and the practice as respects two-shift, two-and-three shift, or three-shift operation. For each of the eighty-six plants, there is given the number of man-hours which were put in—per barrel of cement—in each of that plant's departments, as well as figures for the plant taken as a whole. Table 3 shows the average man-hours, as well as the lowest and highest man-hours, for the plants in each of the three groups of two-shift, three-shift, and two-three shift plants.

TABLE 3

COMPARATIVE LABOR EFFICIENCY, 86 PORTLAND CEMENT PLANTS, 1920

(Data supplied by the Committee on Conservation,
Portland Cement Association)

Shift system	Number of plants	Man-hours to produce one barrel		
		Average all plants in group	Most efficient plant in group	Least efficient plant in group
Two-shift group.....	51	1.035	.551	1.940
Three-shift group.....	22	.823	.466	1.540
Two- three-shift group.....	13	.756	.470	1.140

An important question arises as to whether this clear difference in efficiency is due to the shift system, or to some other factor. The fact that so many plants are included should tend to eliminate averages wide of the mark for purely accidental reasons. But is it possible that all the more progressive concerns might have gone to three shifts, leaving the

less progressive on two shifts, or have the large plants more generally gone to three shifts, or is there something special about the equipment or processes of the twenty-two plants on three shifts, and the thirteen on two-three shifts? The investigator has raised questions such as these with the chairman of the Conservation Committee, the conservation engineer who collected the data for the Association and with others in cement plants, whose sympathies were sometimes with two shifts, sometimes with three shifts. But though these gentlemen have sometimes examined in detail the characteristics of a number of plants, in no case could they see, or had they any reason to suspect, any unfairness in the comparison. The investigator noted that sixteen of the twenty-two three-shift plants were among the forty-six largest plants, and only six among the forty smallest ones. But a comparison of three-shift plants with two-shift plants in the same general class seemed to indicate that not too much importance should be attached to this tendency towards difference in size.

From one viewpoint, the figures show almost too great a superiority in efficiency for the three-shift plants. When it is remembered that usually only 30 or 40 per cent. of the employees in a cement plant are on shift-work, a gain in output per man-hour of 25 per cent., due to reducing the hours of this minority of the men from twelve to eight, is so large as almost to seem to necessitate the conclusion that other factors must to some extent have influenced the figures. If, however, it be considered that the tightening up of efficiency among the shift-workers may have been a means of increasing output and efficiency among the day-workers as well, even though the hours of the latter remained unchanged, then it is seen that the averages are well within the limits of that which is possible, though the story which they tell becomes all the more remarkable.

However the force of these figures might be lessened or strengthened by a more perfect knowledge of the conditions in the several cement plants, the fact that cost figures collected for half an industry should, on their face, be thus favorable to the three-shift plants is impressive. It makes it clear that, whatever may be said of the three-shift system in this specific instance or that, the system cannot on the whole be a source of serious loss. No doubt there are plants where three shifts cost more. But adding all such instances together, the losses are not so great but that, when they are all totaled and combined into one figure with that for other cement plants, the net result is a distinct gain. Indeed, the operating efficiency of the three-shift cement plants is so much above that for the two-shift plants as to more than counter-balance any possible wage differential which the eight-hour shift men might receive.

Combination of Two Shifts and Three Shifts.

The chairman of the Conservation Committee, Mr. Joseph Brobston, firmly believes that three-shift operation is more economical than two-shift operation. It is his view, however, that a combination of two-shift and three-shift operation is, at present, a little more economical than either wholly two-shift or wholly three-shift operation, for the reason that the two-three shift plants put those departments on three shifts where it is more economical to operate three shifts, but leave on two shifts any departments where two-shift operation may be more economical. Nevertheless, he thinks that eventually the eight-hour shift can be put into all the continuous departments and made to pay its way.

Most of the cement plants at Nazareth, Pennsylvania, are operated on the plan of part two shifts, part three shifts, and consequently have given a good deal of attention to the ques-

tion as to just where it is more economical to operate on three shifts. It is the opinion at Nazareth that the most important place about a cement plant in which to have eight-hour shifts is the kiln room. This room contains long horizontal kilns in which the powdered stone is calcinated to a clinker. The work is hot. The kiln fireman should be alert and give careful attention, including frequent observation of what is going on within the kiln. It has been found that on a shorter day a man can be trusted with more kilns. Thus in one cement plant it took four men in the kiln room on two shifts—two per shift, but when the plant went to three shifts, it took only three men—one per shift. In the case of four Nazareth cement plants which put their kiln rooms on three shifts, it was found in each instance that no more men were required, and also that the output of the kilns was increased.

Aside from their kiln room, it was stated at a Nazareth two-three shift plant visited that there had been a reduction in personnel in the drying department and in the handling of clinker, when those departments were put on three shifts. They believed, however, that in the raw crushing, first in stone crushers and then in raw mills of various types, preparatory to burning, and also in the finishing mills, where the clinker is ground to the consistency of flour, it would be difficult to get more production, or use fewer men, on eight-hour than on twelve-hour shifts.

In cement plants, generally, quarrying is day-work only, though it is not uncommon under special circumstances of location or equipment to run quarries on two ten-hour shifts.

The packing of cement in bags or barrels, and the various departments engaged in construction or repair work, as well as common labor, are usually on ten-hour day-work—whether the plant as a whole is on two or three shifts, or mixed.

Sometimes the crushing, and in some instances a greater

or smaller part of the grinding, is to be found on a single shift, but this last is not regarded as satisfactory practice.

It is held at Nazareth that one of the most important advantages of putting a department on three shifts is the elimination of the twenty-four-hour turn, which comes once a week when shifts are rotated.

Plants Entirely on Three Shifts.

Taking up the experience of several cement companies which have put entire plants on three shifts, it was stated at the main office of one of the largest cement producers that because of the instability of the labor situation during the last few years it was impossible to tell what had been the effect of the three-shift system in their plants. But the investigator found that the men in charge of one of the plants were quite sure that operations went better on three shifts. Not much, apparently, had been saved on manning. In the engine room, there had been four men on two shifts, and this was reduced to three men on three shifts, apparently an increase of from eight to only nine men. In the boiler room they at first reduced the number of men from three per shift to two per shift, but they had to increase the number again to three. There was some reduction in manning in the raw mill. But regardless of any savings in manning, the plant managers were positive that in other respects the employees did better work on eight-hour than they had done on twelve-hour shifts. The men, they knew, preferred three shifts, for when individuals were sick, or did not show up for some other reason, other men were sometimes asked, during the emergency, to work twelve hours. This the men would do, but if the practice was continued for any length of time, there was objection, in spite of the much greater earnings paid for twelve hours. One real advantage of the eight-hour shift was the fact that in emergencies the men were more

willing to double shifts and work sixteen hours, than they had been under the old system to work twenty-four hours.

Among the officers of an Illinois cement company, known for its exceptionally high efficiency, there was a measure of the same difference of opinion and uncertainty regarding the net effects of three-shift operation. But here there was no question but that the work went better, the difference of opinion being as to whether, considering wage increases, the system cost more. Under the three-shift system, the output in barrels per man-hour increased about 10 per cent., but the management was disposed to attribute that gain, not so much to increased labor efficiency, as to large expenditures made during this same period for equipment. The management is divided as to whether the new equipment, without the three-shift day, could have produced the increase in output, but it was the opinion of the official who discussed the matter that the greater part was due to the machinery. Nevertheless, the general opinion of the management was that the eight-hour shift worked much more satisfactorily than the old arrangement (which was really an alternation of eleven-hour and thirteen-hour shifts).

One feature at this plant which complicates somewhat the forming of a clear understanding of the results due to the three-shift system alone (as contrasted with the two-shift system) is the fact that day-work, as well as shift-work, was put on eight hours. There are certain departments where the day men still, on occasion, work ten hours. The management said that in some of the departments the day-workers preferred eight hours, but that in one, in particular, they preferred ten hours. In going from eight to ten hours at one time in this department, the company found that the output increased 25 per cent. In the case of this company, it was thought that there had been no reduction in the kiln room manning in going to three shifts.

A Pacific Coast cement company, to which inquiries were addressed, reported that the three-shift system had been installed in February, 1918; that there had been a 50 per cent. increase in the number of shift employees, without any appreciable effect on output, or other gain in efficiency.

While it is possible that some of the broader assertions of doubt or disbelief in improvement in efficiency under three shifts, which are sometimes met with among cement men, might be disproved or modified by a first-hand inquiry into operating conditions in the plants, it is quite probable that various cement plants have adopted the three-shift plan without marked gain in efficiency. This is especially likely of concerns which made the change—as all those so far described did—under war or post-war conditions, when it was exceedingly difficult, even under improved systems of management, to counteract the general tendency towards slackness, confusion, and inefficiency, characteristic of the period. In a study of the effects of three-shift operation, it is highly important, therefore, not to lay too much stress on the experiences of those plants which adopted three shifts between 1915-16 and 1919-20.

Experience of Plants which went to Three Shifts Prior to the War.

In the cement industry, the uncertainties that surround the introduction of three shifts during the war period are considerably clarified by recalling the testimony given prior to, or in the early days of, the War with reference to such concerns as the Atlas Portland Cement Company, and by noting the results obtained by the Dixie Portland Cement Company, which changed to three shifts about April 1, 1921.

The Atlas Portland Cement Company, in 1920 the third largest in the country, started the movement towards three shifts in the cement industry some years ago by putting its

northern plants on that basis. According to published statements made in 1917 by Mr. Baker,³ then with the company, the gain or loss which would be apt to come from three shifts would depend a good deal on whether a plant was well balanced and all departments were running near capacity, or whether some departments were running only part time.

"I was somewhat puzzled," remarked Mr. Baker, "when I heard Mr. Bissell talking, as to whether he was referring to an eight-hour day for a mill that was loaded down pretty heavily—what we might call a well-balanced mill—or whether he was speaking of a mill long on the clinker side or long on the raw side.

"I would say that a plant today that is loaded down heavily, well-balanced, running two full shifts, day and night, seven days a week—that there are many advantages to be gained by the eight-hour day. Undoubtedly you will increase your output. If you are running very close now (that is, with small production), you cannot help but have a higher cost. . . .

"In many cases there are certain labor conditions that can be straightened out effectively by cutting down the number of hours. It has been my experience, and I think the experience of everyone, that every plant that is operated on an eight-hour shift, three shifts a day, thirty-one days a month, running it right through, changing shifts every week and making the cycle every three weeks, gets very efficient operation.

"There is one thing I might say further in regard to what Mr. Brobston brought up in his paper about the labor turnover. We have found it considerably less on our eight-hour shifts than we found it on our regular yard and quarry

³See "Labor Turnover and the Employment Problem in Cement Plants," a paper read by Joseph Brobston at the fall meeting of the Portland Cement Association, September 11, 1917, and published, with discussion, by the Portland Cement Association.

and outside men who work nine or ten hours at our plants . . . [In making a study of labor turnover it was discovered] that about 33¹/₃ per cent. of the men had been with us five years or more; 33¹/₃ per cent. two years or more, 33¹/₃ per cent. less than six months [figures as given]. But when we worked that out among our shift men, we found a rather surprising condition—85 per cent. of the eight-hour shift men had been with the company over five years. This shows that the men like the eight-hour day.”

In the course of the same discussion, further figures were presented by Mr. Bissell of the Texas Portland Cement Company:

“A few weeks ago I was in California. Mr. Carl Leonardt has a kiln there that is the same size as one I have at Houston. He is working his burners on eight-hour shifts, getting about 7,000 barrels a month more for that kiln than I am at Houston. If that is the case, it might pay me to go to an eight-hour shift for my burners.”

Later, with reference to the experience of his own company in reducing the day in the clinker department from twelve to ten hours, Mr. Bissell added:

“We found on our clinker side that when we cut down our men to ten hours we increased the efficiency of that department at least 25 per cent. We were grinding at the rate of less than 4,000 barrels on two twelve-hour shifts, and today we grind at the rate of 5,500 barrels a day on the shorter shift.”

A Plant Which Went to Three Shifts in 1921.

The case of the Dixie Portland Cement Company is of interest because the change occurred as recently as April, 1921, and because it is a southern plant (near Chattanooga) employing about 40 or 50 per cent. colored labor. A large proportion of the colored men are in the quarry or elsewhere

on day-work; but there are also a considerable number engaged on shift-work.

In this plant the change from two to three shifts was a distinct source of profit. The wages of the men were increased from thirty-three cents an hour to forty cents, that is, men on the eight-hour shift received three dollars and twenty cents a day, as compared with three dollars and thirty cents a day received by ten-hour employees. Thus, in going from twelve to eight hours, the men gave up the differential which, as twelve-hour men, they had formerly received over ten-hour men, but the hourly pay of the eight-hour men was so adjusted that their daily earnings did not (for those receiving the base rate) drop more than ten cents below that of the ten-hour men. Later, at the beginning of 1922, the rates were changed to thirty cents an hour for ten-hour men and thirty-six cents an hour for eight-hour men. It will be observed by those familiar with base rates as they ran in different parts of the country in 1921 that the rates above quoted, even the new thirty cent rate for ten-hour work, were well up to the standard prevailing for this kind of work in the North, and much above the level common in the South.

But the gain in efficiency due to going to three shifts would have wiped out a much greater increase in hourly wage-rates than that which the company made. In the first place, three shifts required no more men. Taking all the shift-work, which includes between 40 and 50 per cent. of the employees, the introduction of a third shift was accompanied by only a slight increase in the number of men and this small increase in the number of shift-workers was balanced by a decrease in the number of day-workers. The hours of day-workers were not changed from the old standard of ten hours. But the pace of the day-workers had previously been influenced by the pace set by the twelve-hour

workers, so that the removal of the slack from among the shift-workers resulted in better work on the part of all those employed in the plant. The degree to which the manning scale could be cut varied, of course, in different departments. But it was not an uncommon thing where four men were employed on each of two shifts to get along with three men on each of three shifts, or even less. Thus in the kiln room it was possible to get along with two kiln firemen or burners on each of three shifts in place of three burners on each of two shifts—six altogether under either system. But counting all the men in the kiln room this was one of the departments where it took a few more men on three shifts than on two. In the finished grinding room the head grinder took over the work of the oiler, thus eliminating a job, and similar adjustments were made elsewhere in grinding. In the case of the boiler room (employing colored labor), they were able to get along with as few men on three shifts as they had previously had on two. In the case of the engineers and oilers (who were white) it was possible to eliminate a few, but not to make a striking saving. There was not a single department, however, which changed over from two to three shifts, where the change was not a tangible gain.

It is what the management call the intangible gains which they regard as of most importance. Under the twelve-hour system the men would get to work just in time and then change their clothes after their hours of duty had begun. Now the men are ready to begin work when their turn starts. Similarly at the close of the twelve-hour shift, the management formerly allowed the men to get ready to go home on the company's time. They were supposed to take about fifteen or twenty minutes. As a matter of fact, they would start three-quarters of an hour ahead and that meant not only that production slowed up, but during the last three-quarters of an hour there was more breakage of machinery.

In many respects other than these, it was possible and reasonable to bear down on the men and uphold discipline more firmly on the eight-hour shift than had been the practice on the twelve-hour shift. The management found that fear of overwork on their own part and on that of the men, had, under the twelve-hour shift, led both to overmanning and to general slackness.

Notwithstanding the greatly reduced manning, the output from equipment was increased. Under the twelve-hour system, seven of the eight kilns were about as many as it was possible to keep supplied with material. The employees hated to think of running all eight at one time. Now the simultaneous operation of eight kilns is a matter of course.

The production records of the Dixie Portland Cement Company show the following figures:

Year	Man-hours per barrel
1919.....	.87
1920.....	.91
1921.....	.72
Four months, ending November 30, 1921.....	.61 *

* The change to three-shift operation was made in April, 1921.

That this improvement was not due to any special inefficiency of the plant under the old system is indicated by the fact that of the nine two-shift cement plants in the class of the Dixie Portland Cement Company in 1920, this company's efficiency was almost exactly at the arithmetical average for the group—in fact, much closer to the average than any other of the nine plants.

Both white and colored labor have increased in efficiency. The eight-hour shift is popular with both races. As soon as it was introduced, white men who had never before offered to work in the cement mill, applied for employment. Some

time previous to the change a number of the company's good colored men had been attracted elsewhere, and these came back when the change in shifts was made. There are many applications from men engaged on ten-hour work in the quarry or elsewhere to get on eight-hour shifts.

The accident rates are about the same as in 1920. The management thinks there has been some elimination of material wastes in line with the general tightening up of discipline. It is thought that under the eight-hour arrangement efficiency is as good by night as by day.

The company operates seven days a week. Once a month the shifts rotate. At this time two sets of men take only eight hours off, the third set getting thirty-two hours off. This obviates the necessity of any turn for shift-men of longer than eight hours.

The company's quarry is operated on two ten-hour shifts. The primary crushing runs the same hours as the quarry. All processes beyond the primary crushing—down to the packing—are on continuous-operation. While there is some thought among the management that the day men might be more efficient on a nine-hour than a ten-hour day, they do not see how, with their machinery, they could get the necessary work done in nine hours; they are committed, therefore, to the ten-hour day for day-workers.

CHAPTER VIII

LIME, BRICK, POTTERY

THE LIME INDUSTRY GENERALLY ON TWO SHIFTS

THE lime industry is in some respects analogous to the cement industry. However, it does not have the extensive continuous grinding operations which in cement manufacture precede and follow the burning, and hence the proportion of continuous-operation is smaller in lime than in cement. In the plants personally investigated about 15 per cent. of the men were on shift-work.

In most parts of the country the lime industry is on a two-shift basis. This is particularly true of the East and South.

Experience of One Company with Three Shifts.

The only lime plants in the eastern part of the country, not on two shifts, of which knowledge could be obtained, are the two plants of the Charles Warner Company near Philadelphia. The change to three shifts was put into effect by Mr. Irving Warner, the general plant manager. For three years Mr. Warner had endeavored to get the men to accept three shifts, on the basis of some rearrangement of the work which would make it possible for the company to compete with plants which were on a two-shift basis, but the men were unwilling to undertake more work. The men became interested, however, in getting Sunday off and came forward with a proposition to run the plant six days a week. Mr.

Warner, not thinking that would work out satisfactorily, suggested that, before pressing that request, they give a trial to his own scheme for working eight-hour shifts.

The foremen and men were opposed to three shifts and were reluctant to make a trial, preferring to work easily for twelve hours rather than hard for eight hours. It developed, however, that most of the men working on one battery wished to work eight hours, while those on the other battery wished to remain on twelve. The men on the one battery were told to appoint a committee. The manager drew up a new manning scale, so designed that the same number of men who had operated the battery on two shifts could assume the responsibility for three shifts. He presented the schedule to the committee, who made one small change. It was arranged that the three-shift plan should go into effect on the one battery on Sunday. When the manager came round on Sunday he found both batteries running on three shifts. They have been running three shifts ever since.

The arrangement of continuous work in a lime kiln so that each man can do 50 per cent. more work is often difficult, for the reason that the number of men is small, and the layout is such that there is no simple way of giving a man 50 per cent. more work. In the two plants of the Charles Warner Company there were three different situations, each offering its own problem in the way of a reallocation of the work which would give the necessary increase in responsibility. The manner in which the problem was solved shows how a management can find satisfactory ways of changing to three-shift operation.

Methods and Results.

The Charles Warner Company has two lime plants, a large one at Cedar Hollow with two main kiln groups, and the McCoy plant, which is much smaller. Table 4 shows

the manning scale on two shifts and on three shifts so far as concerns the continuous work on the "small kiln" group at the Cedar Hollow Plant. The seven small kilns which make up the "small kiln" group have two furnaces each.

TABLE 4

SHOWING HOW NINE MEN WORKING EIGHT-HOUR SHIFTS DID WORK OF TEN MEN WORKING TWELVE-HOUR SHIFTS, SMALL LIME KILNS, CEDAR HOLLOW PLANT, CHARLES WARNER COMPANY

Two-shift system		Three-shift system	
Drawman (assisted by firemen on No. 6)	Fireman	{	Kiln 1
			Kiln 2
	Fireman	{	Kiln 3
			Kiln 4
	Fireman (assists drawman)	{	Kiln 5
			Kiln 6
	Fireman	{	Kiln 7
			Kiln 1
		Fireman	Kiln 2
		Kiln 3	
Drawman	{	Kiln 4	
		Kiln 5	
		Fireman	Kiln 6
			Kiln 7

Number men each shift.	5	Number men each shift.	3
Total two shifts.	10	Total three shifts.	9

Under the old system, each fireman had two kilns (or four furnaces, altogether). Under the three-shift system he was assigned three-and-one-half kilns (or seven furnaces altogether). The drawman dispensed with the aid he had formerly received from one of the firemen, thus making it possible for each of the firemen to handle a full quota of kilns.

This plan was not hard to arrange. A more complex situation arose when it came to putting the other kiln group at the large plant on three shifts. This included a large producer gas kiln, three or four times the capacity of an

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ordinary kiln, and some double and single kilns.¹ Table 5 shows how this second problem was solved.

TABLE 5

SHOWING HOW TWELVE MEN WORKING EIGHT-HOUR SHIFTS DID WORK OF TWELVE MEN WORKING TWELVE-HOUR SHIFTS (WITH SLIGHT AMOUNT OF HELP FROM OUTSIDE), LARGE LIME KILNS, CEDAR HOLLOW PLANT, CHARLES WARNER COMPANY

Two-shift system			Three-shift system				
Fireman (assisted by fireman on No. 10)	Very large kiln	21	Drawman (assists in fir- ing Kiln No. 21. Is in turn assisted in drawing by lime hoist- man)	Fireman (assisted by draw- man)	Very large kiln	21	
							Kiln
	Fireman	Double Kiln		12	Fireman	Double Kiln	
							Kiln
	Kiln	14		Kiln	14		
						Kiln	15
Kiln	16	Kiln	16				
				Number men each shift..... 6			Number men each shift..... 4
Total two shifts..... 12			Total three shifts..... 12 (with a little help from lime hoistman)				

It will be observed that the standard task was increased from two single kilns (or four furnaces) on the twelve-hour

¹ It is to be noted that a double kiln requires twice the labor of a single kiln. Theoretically the large producer gas kiln, No. 21, has the status of a double kiln; but it has been the usual practice under both the two-shift and the three-shift system to allow extra help on this kiln, so as to keep it in rapid and efficient operation. Hence in the diagram, No. 21 is represented as though it were the equivalent of three kilns (so far as concerns the allocation of labor). This is only approximately correct.

shift to three single kilns (or six furnaces) on the eight-hour shift. The division of responsibilities under the new plan did not come out quite even, and it will be noted that a little help was given the drawman by a man outside the group, the lime hoistman.²

The Cedar Hollow plant also has a rotary kiln. This was originally on two twelve-hour shifts, the manning of each shift consisting of one man who took care of the producer and firing end of the kiln, and a second who took care of the machinery, including the subsequent lime grinding. However, it was also necessary, as the kiln was fired by producer gas, to bring round a gang of men daily to clean these producers. This made a considerable delay. Later the rotary kiln was put on three eight-hour shifts, but the regular force were allowed an hour's extra pay for cleaning the two producers;³ which they did, one producer during each of two periods of overlap, which occurred between shifts. As there were four good men present during each period of cleaning, the men could make a very quick job of it. More recently, the conditions on the rotary kiln have all been changed, due to the installation of other equipment, but the above was the manner in which the problem was solved at the time.

The situation at the McCoy plant was the most difficult to adjust. Here were two double kilns fired by one man each, the firemen drawing the kilns for one another; but in the summer

²The position of lime hoistman also constitutes a continuous occupation, one man serving both batteries of kilns. It, too, was changed from two twelve-hour to three eight-hour shifts, thereby entailing the cost of one extra man. But the lime hoistmen, under the new arrangement, were able to give sufficient help to the drawmen on the large kilns to avoid the necessity of any increase in manning on the large kilns and the increase by one in their own number was exactly balanced by the saving of one man which occurred on the small kilns. Thus taking the large kilns, the small kilns, and the lime hoistmen together, the change to eight hours was made without increase in personnel, there being twenty-four men employed both before and after the change was put into effect.

³That is, the men were allowed nine hours' pay for eight hours' work plus the cleaning of the producers.

an extra man was employed. Taking the year as a whole, therefore, the average number of firemen per shift was two-and-one-half—two in the winter, and three in summer. Since these were large kilns, and the only ones in the plant, so that no one else could be drawn on for help, the number of firemen was left at two, (winter and summer). Thus under the three-shift system it took six firemen, where under the two-shift system the average for the year had been five. This increase in the average number of firemen required was compensated for by an arrangement by which the men worked nine hours instead of eight, so that two men might work together at poking the lime during the period of overlap. This meant that the kilns were kept open only half as long, and the saving in the loss of heat, due to the greater speed with which the work was done, was important enough to make up for the increase in labor cost.

Because of the drastic cutting of manning scales the company was able to pay the men as much for eight hours as they had formerly received for twelve. To be precise, the pay was four cents a day more. If a man is called on to work beyond the eight hours, it is at the old twelve-hour rate, two-thirds of the new rate, the opposite of the method of paying for overtime usually employed. But overtime work rarely occurs. One of the interesting features of the experience of this company with the three-shift system was the fact that after the new schedule had been established, calling as it did for 50 per cent. more work per hour (but one-third fewer hours), it became popular with everyone.

It is held by this company that one of the reasons why it is more important now than in former years to have a short shift in the lime industry is the fact that lime manufacture has become less intermittent. The development of the hydrated lime process and the building of more adequate storage capacity has reduced materially the number of days

of idle time through the year. Formerly the men would often get off because of protracted wet weather and on Sundays, when business frequently was lighter. This has been changed, because of the present methods of hydrating surplus production.

Other Companies.

It was learned through correspondence that a lime plant in Virginia had tried three shifts with firemen for a period of two years and then gone back to two shifts. The president stated that on going to three shifts the plant efficiency fell off about 20 per cent., and that on going back to two shifts they regained 25 per cent. The nature of this loss in efficiency was not brought out in the correspondence. The head of the company stated that the plant was small, that their information was not in statistical form, and that he did not think their experience important enough to warrant its study.

In the Chattanooga district the two-shift twelve-hour system has been, so far as known, the exclusive practice for half a century at least.

In the middle-west district (centering in Illinois) the three-shift system in lime burning has not been uncommon. According to a letter received from the secretary of the Central Bureau of the National Lime Association, of twelve member plants, four were employing the three-shift system, seven the two-shift system, and one had tried the three-shift plan and changed back to two. However, it seems that in this district the two-shift plan is so operated as not to involve more than ten hours of work by the men.

“At the end of one shift the fires will carry over fairly well, while at the end of the other there is always someone around to replenish them between shifts. Another difficulty that enters is that most kilns do better when drawn four times in twenty-four hours. This means under the three-

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shift plan that one man must draw a kiln twice while the other two draw but once and this leads to difficulties.”

BRICK AND TILE

As already noted, in the manufacture of brick and tile (as well as of pottery and other clay products), the main labor is in the shaping and movement of the product, operations which are performed in the daytime only. In typical brick-making plants it has been found that the continuous-operations require about 11 per cent. of the total employees. Much depends on the type of brick and the plant. In some plants the proportion of shift-workers is less than 11 per cent. This is true especially of plants using gas instead of coal as fuel. Considering that there may be only fifty or eighty employees in a fairly good sized brick plant, the few men employed on shift-work may seem to be almost negligible. When it is considered, however, that there are in the United States more than 100,000 men employed in the brick industries,⁴ it is seen that these groups of five or ten men added together would, on the 11 per cent. basis, amount to 11,000 persons. Even if the average proportion of shift men be somewhat less than 11 per cent., their numbers would still be well in the thousands.

A Twelve-Hour Schedule Usual.

In actual practice little brick burning is on less than a twelve-hour shift schedule. In or near some of the largest cities of the East the hours exceed twelve. In the Hudson River district common brick plants, burners and their assistants work eighteen hours out of each twenty-four, the assistant taking charge during the six hours while the burner is

⁴Census of 1914. In the year 1919 the number of wage earners reported was only 77,000.

away. This system of eighteen hours on, six hours off, is continued for about five days and five nights until the kiln is finished.

In the common brick plants of Philadelphia the former arrangement was for burners and assistants to work thirty-six hours at a stretch, then take twelve hours off, and come on again for another thirty-six hours. Later this system was changed to the present practice under which the burner works twenty-four hours on and twenty-four hours off, while the assistants still work thirty-six hours on and twelve hours off.

The management of a Philadelphia plant investigated claimed that the men wanted the above arrangement. Objection was made when the burners' hours were shortened from thirty-six to twenty-four. The helpers, under the present arrangement, get three days' pay every forty-eight hours.

The total force of burners at this plant (which burns one kiln at a time) consists of two burners and three helpers. Under the twenty-four-hour system for burners, and the thirty-six-hour system for helpers, one burner and two helpers are on duty at all times. The burners do little of the actual firing, which is mainly done by the two burners' helpers, working one on each side of the kiln. The firing takes about fifteen minutes, and then the men have about thirty minutes to rest before firing for another fifteen minutes. The burning of a kiln is completed in slightly less than ninety-six hours. The engineers at this plant were also on twelve-hour shifts.

Thus taking the plant as a whole, out of a total force of about seventy-five employees, there were on long shifts two burners, three burner's helpers, and two engineers. Had the assistant burners been on twelve- or twenty-four-hour, instead of thirty-six-hour, shifts, there would have been four instead of three helpers, which would have brought the proportion of workers on twelve hours (or the equivalent) to $10\frac{1}{2}$ per

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cent. Of the other employees in the plant, those on the brick machines worked about eight hours per day, kiln builders worked piece-work, and common labor day-work for ten hours.

Outside of New York and Philadelphia, these systems of eighteen-hour, twenty-four-hour and thirty-six-hour shifts, which are in those cities regarded as the natural practices in brick-making, were not found by the investigator. The twelve-hour shift is the general rule. The kiln fireman follows a twelve-hour schedule for the greater part of a week until the kiln is done. Then he may immediately fire another kiln or have a waiting period, during which he works on a day-work basis for ten hours. There are a number of plants in various parts of the country where the work is so arranged that the fireman or burner may get off at the end of about eleven hours.

The investigation disclosed no three-shift brick plant in the parts of Pennsylvania visited, though the inquiry, of course, could not be exhaustive. The industry in the South, also, is on two shifts, except in Texas, where it is reported that there are some three-shift operations.

The investigation showed no three-shift brick plant in Ohio. It was reported that a paving brick company at Canton had tried three-shift operations. But on investigation it developed that the management had been trying for fifteen years to get the men to adopt three shifts, but the men would not accept a basis which the company regarded as commercially feasible. The management believed that men working eight hours should forego the differential which as twelve-hour men they had previously enjoyed over the regular ten-hour men. The company was ready to give ten hours' pay for eight hours' work, but was unwilling to pay the eight-hour men more than was received by the mass of employees whose day was ten hours.

An Experiment in West Virginia.

The investigation revealed that three-shift operation had been given a trial in the plants of a large brick company located in West Virginia. About 1914 the company made a first move towards three shifts by putting its head burners on that basis. After a while the management believed that the division of responsibility among three instead of two men was unsatisfactory, so it put the head burners back on two shifts and tried their helpers on three shifts. This method worked satisfactorily and the plan was followed for several years.

The number of kilns fired varies from time to time. When eight kilns were in operation no more helpers were required to handle three shifts than two. When firing eight kilns on two shifts, the company employed two head burners (one on each shift) and six helpers (three on each shift), making eight men altogether. When operating eight kilns on three shifts, the company used two head burners (twelve-hour shifts) and six helpers (two on each shift), still making eight men. But it was only infrequently that eight kilns was the number in operation. When the number was seven, the company employed only two helpers on each of the two shifts, and required two also on each of the three shifts. Under these circumstances it took 50 per cent. more helpers on three shifts. This did not necessarily mean extra cost, for the men were paid only for the time they worked. Wage-rates were advanced at the time of putting the helpers on three shifts, but this would probably have occurred had there been no change in the shift system. While on the whole the results of this company's putting its helpers on three shifts were neutral, or, at the best, slightly beneficial, the management did not regard the trial as a fair test of the value of three shifts. Conditions were extraordinarily bad

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for getting labor efficiency at the time, and the management thought it might have been able to accomplish more in the way of improvement, had the trial of three shifts been under other conditions.

Owing to a labor shortage the company put its helpers back on twelve-hour shifts in 1917. The helpers, who were foreign and of the older un-American type, welcomed the return to the longer hours with their greater pay. As long as they employ this type of labor the management believes that two shifts will be more satisfactory to the men and mean smoother running for the plant.

It is of interest to note that the opposite attitude towards hours was taken by the American-born, or Americanized day-workers in the company's shops. The men who make the brick are firm for an eight-hour day, even as opposed to a nine-hour day. The company had been operating its shops nine hours. An eight-hour day was established in an industry across the river. To meet this, the management proposed to the men that, instead of cutting hours, the men take more pay. The men refused and asked for the cut in hours with the same pay. Later when the question of reducing wages arose, the management again went to the men and suggested that, instead of taking a cut in wages, the men work nine hours for the same money previously received for eight hours. Again the men refused, preferring to take the cut. This same attitude towards hours was taken by the men in the boiler room. The boiler firemen are still on three shifts.

Experiences in the West.

A firebrick plant in Minneapolis tried three eight-hour shifts with the burners for a few months. The division of responsibility among three men was unsatisfactory.

Detailed information has been secured concerning a

Seattle, Washington, brick company which a number of years ago put at least one, and possibly other, of its six plants on three shifts. The work periods were nine rather than eight hours long, so as to provide double gangs three times a day when the fires were cleaned. This doubling up at the time of the hardest work made it possible to cut down the number of men on a shift so that only a slight increase in personnel was required. Thus twelve kiln firemen working on three overlapping shifts of nine hours each (four on a shift) were able to do the same firing that twelve men working on two shifts of twelve hours each (six on a shift) had done. The only increase in personnel was in the case of the burner, it being necessary to have three burners where before there were two. Thus the total force of burners and firemen on two twelve-hour shifts was fourteen, and on three nine-hour shifts, fifteen.

Three-Shift in Illinois—A Face Brick Plant.

It is chiefly in Illinois, however, that the three-shift system in burning brick has been given wide application.

The W-Company's plant is said to be the largest face brick plant in steady operation in the United States. It has sixty-three kilns, of which twenty-five to thirty are on fire at one time: perhaps two-thirds of these are "hot." Until about 1915 this plant had been operated on two shifts. Its employees are organized, and for several years had been asking for a three-shift day. About 1915 the company agreed to go on three-shift operation. Simultaneously a piece-rate system was introduced by which the men were paid so much per "kiln day."

Prior to changing from two to three shifts, the maximum work assigned to one man was one hot kiln, plus one kiln requiring firing once in sixty minutes. At the present time, on eight-hour shifts, the minimum for a man is two and one-

half kilns, all kilns taking the same classification. The actual quotas run from two and one-half to five kilns. The management believes that five kilns are too many for one tender. The tendency of the men is to fire more kilns than they should, rather than fewer.

Under the present arrangement, the men fire once every half hour. It takes about five minutes for each kiln (firing half of the ten fire boxes), or fifteen minutes to fire a quota of three kilns. This gives a man about fifteen minutes every half hour to rest. The alternation of firing and resting is broken only when fires are cleaned. This requires about two hours on each shift. The management would not favor a doubling up at the time of cleaning fires, as it prefers to have each man clean his own fires.

The men who, prior to 1915 on the two-shift system, earned about two dollars a day, were in October, 1921, earn five, six, or even eight dollars a day. According to the management there is no question but that the men prefer the three-shift system. From the above figures it appears that the wage cost per hot kiln to the company was in 1921 no higher than it had been under the old system prior to the War.

The management finds that the men pay better attention to their work and but little difficulty is experienced in securing the desired quality of product. More inspection is required, however. The foremen, who are also on three shifts, are more alert, and instruments provide means of quality control. When the company first went to three shifts only the kiln firemen were changed, leaving the foremen on two shifts, but the foremen asked to go on three shifts. At that time there was a worker known as gauger, who worked only in the daytime. The foremen suggested that his job be eliminated and that they take care of his work themselves. This was done.

It should be observed that the W— Company operates with unusual steadiness through the year. The firemen work from three hundred and twenty-five to three hundred and thirty days a year. Out of a total of some three hundred and fifty employees, some thirty-nine are on eight-hour shifts. These include twenty-six kiln firemen, three foremen, seven boiler room firemen (three on one shift and two on each of the others), and three engineers. The watchmen are on twelve-hour shifts. The men who make the brick have a maximum day of eight-and-a-half hours, but they get through in less than eight hours.

In Indiana are several brick companies working eight-hour shifts. In general the results in these plants are similar to those in the plant just described. That is, the men do as much in eight hours as they formerly did in twelve.

Illinois—A Paving Brick Plant.

The plant of the Purington Paving Brick Company at Galesburg, Illinois, is one of the largest paving brick plants in the world. This company operates its plants on the "open shop" basis. Its experience with eight-hour shifts is summarized in a letter received in November, 1921, from the president of the company.

"Fifteen or twenty years ago we ran our paving brick plant ten hours. By slightly speeding up the brick machines we found we could make all we could take care of in nine hours. About eight years ago we decided that by speeding up our machines more, we could manufacture all the brick in eight hours that we could dry and burn. We therefore put the entire plant on an eight-hour basis, with the exception of the burners, who were working twelve hours,—really about eleven hours rather than twelve as they left about one hour before their time was up and depended upon the next shift to carry the work on.

"After running our plant about one year on an eight-hour basis, we had a great deal of dissatisfaction from the burners, who were complaining that they had to work twelve hours, while the rest of the plant worked eight hours. Again we found the eight-hour day was in effect all over the country, and we decided to make the change ourselves before it was forced on us by our burners. We have worked it long enough to decide that it is much better to work them eight hours. While the cost is higher, still we get enough better burns to pay for the extra cost. During the hot summer months it is quite difficult to keep burners, and at the present time it would be almost impossible to get the burners to work eleven or twelve hours. . . . Our records will show that we are more successful in running the plant on an eight-hour basis than a nine- or ten-hour basis. The burner foremen still work twelve hours."

There are also three-shift brick plants in central Illinois. One of these is on nine-hour shifts, the three overlapping hours coming in the morning when there is extra work for the men to do.

A Question of Technical Progress.

The question of three-shift operation in the brick industry is intimately related to the technical progress of the industry. Until recently this industry has been most conservative in the matter of technical development. Small plants have been operated on traditional lines without very much improvement in technique and with an enormous waste of fuel. Recently advanced designs of kilns and more careful records and methods have been introduced. The continuous kiln, made up of a series of connected chambers, conserves a part of the heat which would otherwise be wasted. The tunnel kiln, in which the burning is continuous, has the possibility of making

brick-making as well as brick-burning a continuous operation. With higher technical standards the industry will be compelled to secure a higher grade of labor.

POTTERY, TERRA COTTA, SPECIAL CLAY PRODUCTS

Under this heading will be considered not only pottery but the various clay products, more expensive than brick and tile, whose process of manufacture and burning presents substantially the same problem in respect to labor shifts. The manufacture of china, sanitary ware, architectural terra cotta, abrasive wheels, and small ceramic products is similar in that, supplementary to an elaborate shaping and manufacturing process carried on by day, there is a small amount of continuous operation in burning. The proportion of employees in these continuous operations is usually about 3 per cent. But it varies all the way from 1 per cent. in some plants and products to percentages in others equal to the 11 per cent. of the brick industry.

In the pottery and allied industries two-shift operation has been the rule. This is the practice followed by the potteries at East Liverpool, Ohio, the leading pottery center in the United States. From the viewpoint of the pottery industry the matter seems of little importance. In the summer the potteries use gas very largely, and almost no one is on duty at night, except one man, who is a sort of watchman and who controls the gas. Likewise few men are required when oil is the fuel. In the case of kilns using coal, a practice which is much extended during the winter, the number of kiln firemen is larger.

In East Liverpool potteries the engineers usually work daytime only, the hours being ten or eleven, and in a few cases twelve. However, in the case of a plant where the twelve-hour employees were actually counted there were em-

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ployed on twelve hours eight firemen (and in winter eight coal passers), four watchmen and eight engineers, making a total of twenty twelve-hour men in summer and twenty-eight in winter out of a total of seven hundred or eight hundred employees—that is, between 2 and 4 per cent.

Labor has been less interested in three shifts in the pottery industry than in others. The pottery industry is one of the most thoroughly organized in the country. All wage-rates and working conditions are established by collective bargaining, the agreements including the burners. Apparently the rules do not prescribe twelve-hour work, but they imply it in the nine-hour clause: "Nine hours shall constitute a day for all day wage-workers excepting engineers, engineers' helpers, kiln firemen, watchmen, oddmen and such others as must from necessity work longer hours." According to the employers no complaints are made by the men or the unions regarding the twelve-hour work.

Some managements in the pottery industry are considering the question of two- and three-shift operation. The general manager of a large New Jersey company manufacturing sanitary ware writes:

"In this plant it has been our custom up to this year to employ twelve-hour shifts. At the present time, however, we are employing eight-hour shifts on the kilns due to reduced operations. It is my personal opinion that twelve-hour shifts ought not to be employed where they can be avoided, although eight-hour shifts are possibly not quite so satisfactory as the twelve-hour shift so far as operating conditions are concerned. Our greatest difficulty, however, has been that the men are dissatisfied when allowed to work only eight hours. This is a situation with which we have considerable difficulty in meeting. From the standpoint of operations I believe that a twelve-hour shift is better than the eight-hour shift as applied to kiln firemen, but from the

human standpoint I do not believe that any man should work twelve hours out of twenty-four."

Most terra cotta companies are on two shifts for the burning operation. But the Northwestern Terra Cotta Company of Chicago is on three shifts. This applies to the kiln firemen, boiler firemen, and engineers who together number about ten or twelve out of a total of three hundred and seventy-two or about 3 per cent. The change to three shifts was made about three years ago. According to the superintendent, the company gets higher efficiency. The quality of the burning of terra cotta depends a good deal on the attention given. The eight-hour shift avoids the necessity for an eighteen-hour turn when shifts rotate. This company has not found it a disadvantage to have three men employed on the burning. The management find that proper supervision can overcome any difficulty.

CHAPTER IX

CHEMICAL INDUSTRIES

Peculiarities and Difficulties.

It is difficult to classify the chemical industries and those other industries which, though not ordinarily regarded as chemical, are based on chemical processes. Under the head of "heavy chemicals" are grouped acids, soda, or other chemical products, produced usually on a large scale and manufactured not so much for themselves as because they are employed as chemical reagents in other industries. Falling within the class of "chemical industries" are various manufactures whose processes are chemical but whose products are usually more or less finished articles of commerce. The term chemical industry also applies, in some sense, to the large industries considered in Chapter X.

The chemical industries in general form the group in which it is most difficult to change to three-shift operation with noticeable increase in efficiency. Where the processes consist in distillations, in the movement of fluids through pipes, in reactions which take place in retorts; when the work is turning valves, waiting for vats to fill, or watching gauges, it is neither easy to hasten processes, nor safe to reduce the number of men. Losses due to overflows, uneven feeds, carelessly regulated temperatures, and mistakes and accidents due to inefficient labor may cause large losses in a chemical plant. But it is harder to measure gains in efficiency due to their elimination and not easy to guarantee that they will not occur again. This situation may account for the

statement which is often made that the eight-hour shift has brought no reduction in manning or increase in efficiency in the chemical industry. The statement applies particularly to plants which changed to three shifts during the War.

On the other hand, there have been some well substantiated and interesting illustrations of successful methods of changing to three shifts, both in the applied chemical industries and in the making of chemicals themselves.

HEAVY CHEMICALS

In the production of heavy chemicals there is a small amount of two-shift operation. In parts of the South, for instance at Birmingham, chemical companies both in the heavy or more general lines and in specialized lines are on twelve-hour shifts. In the North, and through the country generally are small plants which operate on two shifts. This last statement applies also to large companies which have chains of small plants. These companies often have no general labor policy but allow their local managers to follow local customs, which means in some instances two-shift operation. Even in the case of large plants located in the North, there are some which have certain individuals among their employees on twelve-hour shifts, but these companies, as well as many of the companies having chains of plants, are often in other than the purely "heavy chemical" lines. Notwithstanding the exceptions noted, the generalization may be made that the large producers of "heavy chemicals" are on three-shift operation. In the districts where the heavy chemical industry is concentrated the change from a general practice of two-shift operation started some twenty or more years ago, began to proceed more rapidly some ten years ago, and during the last five or six years has taken place with such rapidity and completeness that today three-shift operation is

decidedly the predominating system. But widespread though the change has been, it is difficult to determine what has been the effect on efficiency and cost of the introduction of the three-shift system. In the case of a number of the more important companies, the evidence is not clear as the change was made many years ago. What these companies have been most concerned with in recent years have been changes, not from twelve to eight hours, but from nine to eight hours, or from a seven-day to a six-day week. In the case of other companies the results have been influenced by the fact that the adjustment was made under war conditions. But even where these factors have not been prominent the conclusions with regard to heavy chemical plants have usually been more a matter of opinion and report than of measured fact.

In most cases the managers of heavy chemical plants express doubt as to any marked improvement in efficiency under three-shift operation. Most of the managers have held that three shifts could bring no increase in output. At the same time there is a considerable body of opinion to the effect that fewer accidents in processes, less loss and inferior work, ought to prevail where the men are on an eight-hour instead of a twelve-hour shift.

This prevalent uncertainty regarding the effects on production of three shifts does not mean, however, that the makers of heavy chemicals feel regret at having gone to three shifts or are contemplating returning to the older system. With a few exceptions the companies seem to be content with the three-shift system. As a matter of fact, the labor cost of an extra shift is not large in a chemical plant. The proportion of shift-workers in the chemical industry is less than in many of the other continuous-industries. In most cases the proportion of shift men would not be more than about 20 per cent. of the total. From that number it would vary downward to a minimum as low as 4 per cent.

Experience of a Tennessee Company.

The most definite information obtained for any of the heavy chemical plants was that furnished by the Tennessee Copper Company, which put its sulphuric acid plant on three shifts in February, 1919. In this case, where figures as well as opinions are given, the showing of three-shift operation is much better than the statements commonly made by managers of chemical plants indicate. According to the management of this company, the number of men required to man a sulphuric acid plant is not unalterable, nor is the output of acid something that is absolutely fixed, independent of the character of operation. In a preceding section it was noted how this company was able by building a bridge between two acid towers to have one man do work which had previously required two. It was in part because of numerous savings in manning of this sort, and also because of better control in acid production, leading to larger output, that the pre-war, two-shift system standard of production, which in 1913 was .372 tons of acid per man per day, had by 1921, under the three-shift system, risen to .878 tons per man per day. The figures quoted include employees in mining and smelting (for all of whom hours had been shortened) as well as those in the acid plant; but the improvement in the acid seems to have been greater than the improvement elsewhere. It should be noted that during this eight-year period, there had been a number of improvements in the plant and process. That the striking gains shown were in part due to labor is borne out by the fact that in the brief interval which elapsed between the spring of 1921 (April, May and June) and December of the same year, the operating cost of acid making was reduced 43 per cent., wage-rates meanwhile remaining unchanged. This reduction in cost occurred two years after the first introduction of three shifts. It was accompanied

and furthered by efforts along lines other than the reduction in hours to improve labor relations and efficiency. But the management regarded the improvement as in the main merely a deferred gain which had been made possible by the shortening of hours. The superintendent of the acid plant, a man of extended experience in acid making under the three-shift system in this company and the two-shift system elsewhere, was positive in attributing this last increase in efficiency and output to the eight-hour as contrasted with the twelve-hour day.

The experience of the Tennessee Copper Company makes clear that the manning and output of a chemical plant are far from being fixed quantities even where the equipment is unchanged.

At one time some of the chemical companies operated three nine-hour shifts. One large company, which arranged its shifts so that two sets of men were on duty between 1 p. m. and 4 p. m., found this plan satisfactory. But this company and the other chemical companies have since changed to three eight-hour shifts.

In some of the heavy chemical plants, day-workers as well as shift-workers are on eight hours; in others the day-workers are on nine hours.

FERTILIZERS

There are several hundred general service fertilizer plants in the United States, widely distributed throughout the country. The bulk of the work in such a plant consists in mixing ingredients, getting fertilizer ready for shipment, and doing similar unskilled jobs on a day-work basis. The sulphuric acid department is the only one that has shift labor and the number of employees in that department is

very small in any one establishment. A fertilizer plant may have from one hundred to two hundred employees—sometimes more during the busy season—engaged on day-work. The largest plant would not have more than eight or nine shift men, and a more common number would be five or six. For this number of men continuous work is unavoidable.

The acid plant employees in fertilizer works are universally on twelve-hour shifts, or shifts averaging twelve hours. During the War, there were a few odd instances of plants changing to three shifts, but the owners of these plants say that they have since put the men back on two shifts. While it is impossible to be sure that there is no acid plant now using the three-shift system, inquiry has failed to disclose any.

The problem of going from two to three shifts in a fertilizer works acid plant differs in two important respects from the same problem as applied to a large acid plant.

1. The smallness of the fertilizer plant unit makes more difficult the working out of reductions in manning. If a plant has only two men by night and two by day, it is hard to cut out one or more of this force. The problem is also difficult for a plant employing five or six men.
2. The acid made in a fertilizer works does not need to be chemically pure. The important thing is quantity and cheapness. So the question of *quality of product* hardly enters in as an important reason for striving, through shortening hours, for a good, wide-awake type of labor. The fertilizer companies claim, moreover, that while their day-workers are often unskilled and shiftless, their acid plant employees are drawn from a steady, settled class of labor.

That fertilizer acid plants could with profit be put on three shifts is, however, the opinion of Mr. G. E. Beavers, the acid plant superintendent of the Tennessee Copper Company. He bases his view both on experience with three-shift operation with his present company and on his earlier experience with two-shift operation with a southern fertilizer concern.

In the fertilizer acid plant of which Mr. Beavers was formerly superintendent there were altogether 10 employees, of which 8 were on shift-work. Each of the two shifts had 1 chamber man, 1 pump man, 1 nitro man and 1 furnace man. The two men who were attached only to the day shift were known as acid maker and flunkeyman. If this plant had been put on eight-hour in place of twelve-hour shifts, Mr. Beavers said that the positions of chamber man and pumpman could have been combined, and also those of nitro man and furnace man. That would have reduced the number of shift employees from 8 on two shifts to 6 on three shifts and the total of all employees from 10 to 8. Similar adjustments would be possible, he says, in the case of the smaller plants which now employ only 5 or 6 employees.

In Mr. Beavers' opinion not only reductions in manning, but other important savings could be effected by changing to three shifts. He regards it as a mistake to assume that because only low-grade and impure acid is required for a fertilizer plant, it is not important to maintain good chemical control in the manufacture. For example, sulphur should be charged regularly, but in the two-shift plant where Mr. Beavers was superintendent, towards five or six o'clock in the morning the men would go to sleep, forget to charge, and the production of acid would go down. Or the charging of sodium nitrate may be neglected, on the one hand, or be excessive, on the other, and thus become another source of waste.

Mr. Beavers says that the younger men who are now entering the fertilizer field recognize the importance of attention to these details, and that with more care they will be able to make the plants pay better. But it is hard to bring the employees to time on these matters when they are working twelve hours.

In the Fall of 1918 Mr. Beavers endeavored to put the fertilizer acid plant of which he was then superintendent on three shifts; but the men could not at that time be induced to take it up. A few months later the three-shift system was, however, introduced with great success in the acid plant of which he has since become superintendent. While the latter plant is vastly larger, Mr. Beavers holds that the problem, and the methods to be pursued, are essentially similar.

EXPLOSIVES

Explosives are made in many small plants to reduce the hazard of manufacture, the employees numbering in a few instances no more than ten persons. Taking all the plants together the manufacture of explosives requires very few shift employees. Because of the scattered character of this industry the various plants follow local practices. There may be a few small plants here and there which are on two shifts, but the management of the leading manufacturer of explosives reports that all their large plants have their continuous-work on three shifts.

DYES

The manufacture of dyes, generally carried on in large, costly plants, is notable for the large number of its products, involving processes of many types. While few of the processes are necessarily continuous, and the main processes may

be shut down at night, it is the general custom to run more or less continuously.

One of the leading dye companies reports that when any of its plants operate at night the supervisors are usually on two shifts: a day man and a night man, though sometimes there might be two night men on three shifts. Ordinarily a night supervisor has little work to do. If anything goes wrong he shuts off the process, or calls someone from the central mechanical force to make the necessary repairs. He may not even be on hand all night. The power plants of this company are on three shifts. Maintenance men are for the most part on eight-hour shifts. In general the two-shift work is in places where the men do not have to be in the plant the full twelve hours, or where the process does not run altogether continuously, as, for instance, only for sixteen hours.

Aside from the groups named there are some other men about the plant who are on full twelve-hour shifts, but they are few in number. The company has no definite policy regarding twelve-hour work, but on the whole it is tending away from rather than towards twelve hours.

In another dye plant the continuous-operation work, at the time of the inquiry, was on eleven-hour and thirteen-hour shifts, but the proportion of such work was small. The plant was running slack and there were not more than a score of men on the two-shift schedule.

INDUSTRIAL ALCOHOL

The chief plants of the company which manufactures most of the industrial alcohol are on three shifts. One small plant is on two shifts. While some of the products of this company are manufactured in batches, the alcohol itself is produced by continuous process. Possibly twenty-five per cent. of the employees are shift-workers.

WOOD DISTILLATION

No field study was attempted in the case of wood distillation. The industry is carried on in numerous plants, small and difficult to reach, employing altogether about 33,000 persons.

The Census of Manufactures distinguishes between "turpentine and resin" on the one hand which consists in the extraction and later the distillation of gum from live trees, and which employed in 1919 about 28,000 workers, and "wood distillation, not including turpentine and resin" (which employed about 5,000 workers). It is explained in the census reports, however, that the latter classification really includes all destructive distillation of wood, whether the product be wood alcohol, as in the hardwood distillation of the North, or turpentine and resin, as in the distillation of pine in the South.

A manufacturer, familiar with the production of turpentine and resin from gum, states that there is no systematic operation of labor shifts. Though conducted on a large scale, the industry is carried on much as the farmers boil maple syrup in the North, without special reference to the working hours, or any other conventions of importance. Almost half of the industry is in Florida, and a fourth in Georgia.

The census figures show, however, that there is a considerable proportion of twelve-hour work in the smaller industry which may properly be spoken of as "wood distillation." Something like four-fifths of this industry consists of the distillation of hard woods, and is carried on mainly in the states of Pennsylvania, New York and Michigan. The twelve-hour shift evidently exists to some extent in the North, though it is impossible to tell from the statistics how common the practice may be. Of wood distillation in the South, the authority cited above says:

"In the wood turpentine industry, on the other hand, while the processes, machinery and products differ very widely in the different plants, nearly all are operated on a twenty-four-hour basis, though with heavier shifts in the daytime. Some plants run on two twelve-hour shifts. We do not think there are more than two or three that employ eight-hour shifts and in others the shifts are arranged arbitrarily to favor the process, usually with some provision to change about, so that the men can work on day shifts one week and take a night shift the next—turn about."

With three or four exceptions, the wood distillation plants in the South do not run steadily, but are carried on in a desultory manner, subject to extreme variation in activity.

REFINED CORN PRODUCTS

No extended study has been attempted of the manufacture of starch, glucose and syrups, in what might be called the chemical end of the food industries. A company which holds a leading position in the refining of corn products operates its plants on the three-shift system. Following the close of the War, the company planned to lengthen the hours of its day-workers from eight to nine or ten, but to keep the employees on three eight-hour shifts in the case of continuous operations.

SOAP

Soap manufacture is a daytime affair in the majority of plants except for a few men engaged in auxiliary processes who are often on twelve-hour shifts. Except in an emergency, indeed, the general sentiment among soap-makers is against continuous-operation of their plants. Ordinarily soap vats are boiled by day and allowed to settle by night. A Camden, New Jersey, plant manager believes in using two

twelve-hour shifts for certain of the finishing operations, when the market permits the plant to run to sufficient capacity. But it is several years since the plant was run on that basis and then only for a short time. Another soap company of national reputation runs two shifts when business demands it.

Here and there a soap company runs a considerable portion of its plant continuously, either because it undertakes more preliminary treatment of raw materials than is common or because it manufactures products other than soap for which continuous operation is advisable. Because of the generally greater equipment which such a plant has, it tends even in those processes which are common to other soap companies towards continuous-operation.

Experience of the Procter & Gamble Company.

The conditions which have just been enumerated apply with special force to the Procter & Gamble Company which has about 25 per cent. of the employees in its Ivorydale plant on continuous-operation work.

Prior to March, 1919, these continuous-operation employees were on twelve-hour shifts, or eleven hours by day and thirteen hours by night. At that time the company substituted three eight-hour shifts, at the same time making an effort for greater efficiency. The aim of the superintendent and foremen was to obtain as much work in eight hours as had previously been done in ten. While it was impossible for the management to determine the per cent. of increased efficiency it is certain that the gain in efficiency was considerable, but that it must be credited in part to the increased effort.

In the spring of 1921, the company placed its day-workers on a nine-hour instead of an eight-hour day, giving them eight hours' pay for nine hours' work in lieu of a wage re-

duction. To put the shift men on a parity with the day men, the company decided to modify the three-shift system. The compromise adopted—in a sense a two-and-a-half shift system—is called a five-shift system.

Under the five-shift system all of the shift-workers are given daily turns of nine or ten hours (or according to a later modification, eight-and-one-half, ten, or ten-and-one-half hours). The number of shift-workers is constant throughout the twenty-four hours, and each man reports for duty on the same hour each day in the week.¹ The manner in which this result was accomplished may be seen by an examination of Table 6 (earlier plan) or Table 7 (later plan).

The conspicuous feature of both plans is the introduction of two interweaving series of shift-workers. At any one moment there are always two shifts on duty, as A and B, the one, however, always being relieved before the other. When a shift-worker reports for duty the second day it is not, strictly speaking, to his former position. The second day he relieves, not those who have relieved him, but those who have relieved his neighbor. Thus under the earlier plan Group A, working from 12 midnight to 10 A. M. Monday was relieved by Group D, working from 10 A. M. to 8 P. M. and then by Group B which worked from 8 P. M. Monday to 6 A. M. Tuesday. Group A, coming on again Tuesday could not relieve Group B, for the hours would not come out even. Group E, which Group A relieved, in turn had relieved Group C, which in turn had relieved Group B being the group which throughout most of Monday worked alongside of Group A.

The Ivorydale plant is practically closed down on Sunday (under the later plan, from 7 A. M. Sunday to 7 A. M. Monday). This means that, under the earlier plan, the working

¹ Under the original plan, there was sometimes a slight exception to this at the beginning or end of the week.

TABLE 6
FIVE-SHIFT SYSTEM, PROCTER & GAMBLE COMPANY, EARLIER PLAN

SHIFT	Monday		Tuesday		Wednesday		Thursday		Friday		Saturday		Sunday		Hours per Week
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	
Shift A		10		10		10		10		10		12			62
Shift D			8	8		8		8		8		8			62
Shift B				6		6		6		6		6			56
Shift C						3		3		3		3			54
Shift E								3		3		3			54

TABLE 7
FIVE-SHIFT SYSTEM, PROCTER & GAMBLE COMPANY, LATER PLAN

SHIFT	Monday		Tuesday		Wednesday		Thursday		Friday		Saturday		Sunday		Hours per Week
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	
Shift A		10		10		10		10		10		10		7	57
Shift D			8 ³⁰	8 ³⁰		8 ³⁰		8 ³⁰		8 ³⁰		8 ³⁰		7	63
Shift B				7		7		7		7		7		7	63
Shift C						3 ³⁰		3 ³⁰		3 ³⁰		3 ³⁰		3 ³⁰	51
Shift E								3 ³⁰		3 ³⁰		3 ³⁰		3 ³⁰	51

← Actual operation begins. Time between 7 and 10 A.M. Monday devoted to repairing and inspection of machines.

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weeks of Groups A and D which were scheduled for ten hours a day—excepting twelve-hour shifts on Saturday—was sixty-two hours a week. Group B, which also worked ten hours, but was scheduled for only a short turn Sunday night, worked fifty-six hours. Groups C and E which were the nine-hour groups, worked fifty-four hours. In actual practice, however, groups A and D were commonly relieved two hours earlier than the schedule shows on Saturday, giving them in fact, a sixty-hour week. Group B, on the other hand, would most likely come early Sunday night, probably at 8 P. M. to do odd work about the plant, which would give this group also an even sixty-hour week. The shifts ordinarily rotated once a week. So under ordinary circumstances, a man would work sixty hours three weeks out of five, and fifty-four hours the other two weeks.

Since the investigator's visit to the plant, the plan illustrated by Table 6 has been displaced by the plan illustrated by Table 7. The latter plan eliminates twelve-hour shifts on Saturday, besides changing the period of shut down from the earlier arrangement of Saturday midnight to Sunday midnight, to the present arrangement of 7 A. M. Sunday to 7 A. M. Monday. The shifts are now eight-and-one-half hours for two groups, ten hours for one group, and ten-and-one-half hours for two groups, the ten-hour group getting off three hours early on Sunday. This makes the working week fifty-one hours for two groups, fifty-seven hours for one group and sixty-three hours for two groups, or an average of fifty-seven hours. Under the present plan, the men rotate shifts every two weeks.

The five-shift system as thus outlined has two important characteristics other than its even succession of nine- and ten-hour (or eight-and-one-half, ten, and ten-and-one-half hour) shifts.

1. Never more than half of the men are relieved at any one time, obtaining thereby a greater continuity in the work.
2. A man does not continue today the work which he did yesterday, but takes up what his neighbor on the parallel shift had been doing. This often makes it necessary to teach men to serve in two positions. It will be observed that no shift begins or ends work between 12 midnight and 6 A.M. (Under the present plan, no shift begins earlier than 7 A.M.)

At the end of the first six months of operation under the five-shift system, the company expressed satisfaction with the plan. The production per hour was as much as under the three-shift system. The results were decidedly better than under the two twelve-hour shift system. The five-shift arrangement meant somewhat more effort on the part of the management because of having to teach workmen two different jobs.

The company believes that the men are better satisfied under the five- than under the two-shift system. As between the five-shift and three-shift systems, the adoption of the five-shift system was approved by vote of the men. However, the company previously made it clear that the plant would change to a nine-hour basis, and the vote was on the details of the plan rather than on the general policy involved.

GLUE

No survey has been made of the glue industry. But a Chicago glue company, a subsidiary of one of the packers, was found to have 10 per cent. of its men on continuous processes, and these were on three shifts. They had been changed from two shifts.

DRUGS, PERFUMES, FINE CHEMICALS

The manufacture of drugs and fine chemicals in St. Louis and Detroit is on three eight-hour shifts.

The president of a St. Louis chemical company states that his concern has about 1,000 employees, of whom one-fifth or less are on shifts. When the number of its employees was small, this company ran on two twelve-hour shifts, but the twelve-hour shift was done away with long ago. Even the watchmen are now on three eight-hour shifts. Day-workers are on nine hours.

The New Jersey plant of a French manufacturer of perfumes has its continuous work on three shifts.

ELECTRO-CHEMICAL INDUSTRIES

Investigations show that most of the plants at Niagara Falls which use electricity for chemical purposes are on three shifts.

The Carborundum Company has always had all of its continuous-operations on three shifts.

Another company whose men are on hot and heavy continuous furnace operation has been on three shifts for more than twenty years. The management believes that this schedule is the most satisfactory and economical method for these operations, and that production efficiency is greater and the physical efficiency of the men better maintained. That three-shift operation is more satisfactory to the men is indicated by the fact that though there was formerly a twelve-hour plant across the Canadian border where the men could earn more money, the company had no difficulty in getting labor.

Another Niagara Falls plant was on twelve-hour shifts for continuous work until the summer of 1919. Then a

change was made to three shifts. One-third more shift-workers were required and they now constitute about one-tenth of the total force. Under the three-shift system:

1. The output was unchanged.
2. The product was better in quality.
3. Better care was taken of equipment.
4. Waste was reduced.

The new electro-chemical industry of the South is on twelve-hour shifts. At least this was found to be true of the important electro-chemical center in Alabama.

CHAPTER X

SUGAR, SALT, PETROLEUM, COTTONSEED AND OTHER VEGETABLE OILS

SUGAR

THERE are three branches of the sugar industry, all employing continuous processes.

1. The sugar mills of the South which refine Louisiana cane sugar.
2. The sugar refineries of the Atlantic, Pacific and Gulf seaboard, which refine imported sugar.
3. The beet sugar factories of the interior, located especially in Michigan and Colorado, which perform all the processes from washing the beets to the last stages of refining.

The Louisiana and beet sugar industries are seasonal, doing their work in from forty-five to a maximum of ninety or one hundred days after the harvest. The refining of imported raw sugar may be carried on throughout the year.

Louisiana Cane Sugar.

So far as could be learned by correspondence, the Louisiana mills which refine Louisiana sugar are all on twelve-hour shifts. Nearly all of the employees are on shift-work. Some plants have worked on six-hour shifts with two alternating crews; others are on the straight twelve-

hour shift. One Texas refinery formerly had four sets of men, it being the rule for the twelve-hour men to work an hour and lay off an hour, but this plant is now on a straight two-shift system. The two-shift system seems to be universally established in the industry, with no thought of any other arrangement.

Refining of Imported Sugar.

The refining of imported raw sugar is continuous-process throughout, excepting for the unloading of raw sugar, the packing and delivering of the finished product, and the work of mechanical upkeep and of the office. Inasmuch, however, as the departments named, especially those charged with the duty of filling many small packages, require many employees, the percentage of actual shift-workers may be no greater than 50 per cent.

The majority of the sugar refining companies of the United States operate on two shifts, save for certain jobs such as that of sugar boiler, which is generally on eight-hour shifts. The American Sugar Refining Company, which during the War refined between 35 and 40 per cent. of all the sugar, operates its plants on three shifts. In addition to this there are two or three smaller refineries on the three-shift basis.

More than usual importance attaches to the question as to whether a sugar refinery can operate on three shifts without increasing cost. The industry in both manufacturing and retailing, is an example of a tremendous business done on a moderate and indeed close margin of profit. Competition is intense. It would be impossible for one company to assume a manufacturing cost substantially higher than others. So it is worth while to give special attention to the experience of the American Sugar Refining Company, which went to three shifts in the spring of 1918.

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There are two elements in the question of the cost of making such a change:

1. The extra compensation due to increased hourly rates.
2. Productive efficiency.

In the case of the American Sugar Refining Company the first of these two elements was so favorable on three-shift operation as practically to solve the problem of cost.

At the time of the change in the spring of 1918 there was no demand for a reduction in hours, but general conditions were such as to make labor difficulties likely at any time. It happened that a general increase in wages was about due. In view of the general conditions and its long desire to change to three shifts, the management seized this opportunity to put hours and wages on such a basis as to avoid friction. The management reduced the hours from twelve to eight and increased the hourly wage rate. The men thereby suffered no appreciable loss in weekly earnings. The company, on the other hand, was not faced with a wage cost greater than it would have been had there been no change in hours.

Shortly after the American Sugar Refinery went from twelve to eight hours with an advance in hourly wage-rates, the other sugar refineries, with plants on the same water fronts, increased their hourly wage-rates in an equal proportion but remained on twelve hours. Thus their employees received 50 per cent. greater weekly earnings, and this condition has continued down to the present. Nevertheless throughout the extreme labor shortage of 1918, as well as through all the period that has since elapsed, the three-shift plants had no difficulty in keeping up their complement of men. Further evidence that the men prefer three shifts develops when there is overtime. If overtime work is con-

tinued very long, there is decided objection on the part of the men, notwithstanding the extra pay.

The change to three shifts also worked out favorably as respects the second aspect of the cost question, productive efficiency. The company has no exact figures covering the subject but it is the judgment of the men in charge both in the general office and in the largest of the refineries that the efficiency of employees is 15 per cent. higher than it was on two-shift operation. The management knows, for instance, that on jobs where the work has remained substantially unchanged the men are doing more now than their predecessors were doing ten years ago. The figure quoted does not have reference to the output of equipment, but that has improved. Since having changed to the shorter shift periods, there have been outstanding months at each one of the refineries, which have shown an increased output over months for many years past. The management says that absenteeism and labor turnover have decreased.

Table 8 illustrates an interesting feature of the three-shift system as worked out at the Brooklyn Refinery. It is a plan for providing one day's rest in seven (as required by the New York State Law) without the introduction of relief men (or attempting to secure exemption, as permitted by law, by establishing shifts uniformly of eight hours). The refinery shuts down for twelve (or thirteen) hours on Sunday, which helps somewhat. But the necessity of providing a full twenty-four hours of rest, and at the same time rotating shifts, presented a complicated problem which, it will be seen, was worked out with unique results. The day-workers of the American Sugar Refining Company are on a fifty-hour week, with a few on sixty hours. On Sunday about two hundred men (in the one refinery) work on repairs which cannot be done during the week. These men are given a week-day off.

Beet Sugar.

Almost all of the beet sugar plants of the United States are on twelve-hour shifts. At a plant investigated all but about fifteen of the two hundred and twenty-five employees were on shift-work. However, the operating season is not longer than ninety days, and during the balance of the year the men either work shorter hours at overhauling the plant or find work elsewhere. In Michigan the same men come back year after year in order to obtain the large earnings for twelve-hour work.

One company having several plants operating from a main office at Toledo, Ohio, tried three shifts during the season of 1920-21. But when the plants reopened in the fall of 1921 it was on a two-shift basis. The management said that this was primarily because of hard times in the industry, the lower prices of sugar, the poorer beet crop and the lower wage-rates. The return to two shifts was not regarded as a matter necessarily of permanent policy, or a rejection of the three-shift system. While on three shifts the company had not noted any improvement in efficiency. It had no difficulty, however, arising from the shortness of the season, in getting labor, or in otherwise operating on the three-shift system.

In another locality an important company has had its plants operating on three shifts for the last three seasons. In November, 1921, the general superintendent of this company wrote:

"Our company adopted the three-shift system October 1, 1919. This change had been under consideration for some time prior to its adoption, but before the end of the war we did not think it wise to attempt to draw from other essential industries the necessary excess number of men to make the three-shift system successful. It was our hope that if the

TABLE 8

ONE DAY'S REST IN SEVEN AS WORKED OUT IN THE BROOKLYN PLANT OF THE AMERICAN SUGAR REFINING COMPANY

	Friday	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Monday
Group III	7 3	9 7	3 rd 7 2 7 Week	11 7	11 7	11 7	11 7	7 11	9 10	11 7	3 11
Group II	3 11	7 12	7 2 7 Week	7 3				7 3	9 10	7 12	7 11
Group I	7 11	9 11	1 st 7 11 Week	3 11	3 11	3 11	3 11	3 11	7 11	7 12	7 3

According to the schedule, the groups work 54, 50 and 52 hours per week, or 52 hours per week average. Overtime is paid for any work done between 7 A.M. Sunday and 7 A.M. Monday, so as to make the average number of hours' pay per week amount to 54. But ordinarily the work stops at 6 A.M. rather than 7 A.M. Sunday morning giving an actual weekly average of 53½ hours' pay.

It will be observed that two Sundays out of three the men get 24 hours off, the third Sunday 54 hours. One week end, a given group works one 10-hour shift; the next week end it works one 12-hour shift; and the third week end it works a 10-hour shift before and a 12-hour shift after the period off. Through the week all shifts are 8 hours. The minimum rest period between shifts is 16 hours.

The plant itself operates all but 12 hours, or in practice 13 hours, out of the week.

three-shift system were adopted, more intensive work could be expected during the shorter work period resulting in a smaller number of men per shift, higher production rate of our factories and possibly a better quality of work performed, all of which circumstances might combine so as to result in no increase of labor cost per unit of production. We also anticipated a lower rate of replacement of men, particularly of key men.

"For seven years prior to the change we found our number of operating men required to be practically constant from year to year, and think it represented practically a minimum crew under these conditions. While, after the change we had to overcome the dis-inclination of labor to work efficiently, which required about two years, we feel that we are again very near to a minimum basis as to number of men under present conditions, and find that we require only 87 per cent. of the number of men per shift required for seven years before the change. This smaller number of men has increased capacity over 22 per cent. We feel that the three-shift system is only one factor in the increased capacity of our plants, but that it is nevertheless one very important factor. We also find that a better quality of work is being performed since the change, as measured by losses in production and economy in use of materials. Other factors than the hours of labor, of course, have a bearing on higher efficiency. . . .

"Our management is necessarily gratified over the results of the three-shift system and feels a satisfaction in the greater contentment of our men under improved working conditions. This arrangement, however, places a greater burden on those directly in charge of each factory unit in that the necessary supervision of three shifts necessitates long hours of vigilance on their part. We operate three shifts this season.

"Our operations are seasonal, each campaign lasting approximately one hundred days. Being seasonal in character, the addition of one new shift involves supplying the necessary number of men, an adequate supply of whom must be on hand on a certain date each year. So far, we have had no serious difficulty in procuring enough men, but in a period when the supply of labor is short, the three-shift system might complicate matters for us considerably."

The general superintendent further explains that the raw product, being a vegetable, must on account of freezing weather be harvested faster than it can be treated, necessitating the placing of the excess in storage. This accentuates the necessity of high-speed treatment. And it makes especially important the operation of the plants to full capacity, which, as the figures already quoted have shown, "can best be attained by three shifts of moderately fresh men as against two tired shifts, which would be the case where men work twelve hours per day for a steady grind of one hundred days."

While the general superintendent does not know definitely what rates would be necessary to secure adequate labor under the two-shift system, "We think," he writes, "that our hourly rate on labor is now 30 per cent. higher than we would offer under a two-shift system and that the monthly rates applying to key men are substantially the same under both systems." And again, "the majority of our men are very enthusiastic over the three-shift plan. . . . A change to the two-shift system would undoubtedly cause a great deal of discontent at this time."

TABLE SALT

The salt industry, small in the number of men employed, varies in the amount of continuous-process work. In some plants only certain processes are continuous. In others,

practically the entire plant runs continuously except for construction and repair work and the putting of salt into small packages.

Until within a few years the three-shift system was practically unknown in the salt industry, except for a large Akron plant, which changed to three shifts about ten years ago. Even today in some sections of the country, the two-shift system is the prevailing system. As in the sugar industry, a large volume of business is done on a small profit. The work is largely that of attending processes rather than hard manual labor. Managers used to say that one concern could not go on three shifts unless all did.

In New York State, in sections where most of the plants are still on two shifts, one company with headquarters at Ithaca changed to three shifts about three years ago. It reports no gain in the efficiency of the men. War conditions made it necessary to shorten hours, and pre-war efficiency had not been regained as late as December, 1921. The men prefer the three shifts, provided the present wages continue. Notwithstanding this rather unfavorable report, the management states that if any change is made it will reduce wages rather than lengthen hours. There is no desire to go back to the two-shift system.

In Michigan practically all the large salt works are operating on three shifts. In the northern section one small plant (employing twenty men, six on shifts) was on a two-shift basis. In the same city a larger plant was on three shifts. Elsewhere in Michigan there are instances of salt works on two shifts. In the territory bordering the Saint Clair River north of Detroit, all the works apparently are on three shifts. One company having works in Michigan, Kansas and Texas, has all its plants on three shifts.

In these large Michigan plants some with as many as five hundred employees, perhaps one-third to one-half of

whom are on shift-work, the twelve-hour day is thought to be a thing of the past. At one plant it was said that three shifts had worked satisfactorily. The management of this plant thought at first that they could also get along with as few men on eight-hour shifts as on twelve-hour shifts. But in the course of a year they found they had almost as many men on a shift as they had had before. At another plant it was said that while the older men might be no more efficient on three shifts, the new men could not be got to work twelve hours.

The salt producers' association, located at Detroit, stated that early in 1921 practically all the salt companies were on three shifts. The statement regarding the extent of three-shift operation evidently reflected the western situation rather than the practice in the East, in parts of which two shifts are still employed. Though the three-shift system is clearly not universal in the salt industry, and though there may have been some tendency towards change both ways, it would appear that in a substantial part of the industry the three-shift system is permanent. Some of the companies state that there have been improvements in production.

PETROLEUM

The refining of petroleum is one of the few industries in which no examples were found of twelve-hour operations. This may not mean that for a certainty there are no two-shift petroleum refineries, but the Standard Oil groups are solidly on three shifts, the "independents" on the Gulf say that they are on three shifts and a very small refinery at Pittsburgh, running on three shifts, took it for granted that there was no alternative. Every one consulted has been of the opinion that the practice is universal.

At one time there existed in the oil industry a twenty-

four hour shift. In order that there might be as little break as possible in the supervision, or distillation, two men would work twenty-four hours on and twenty-four hours off.

Shortly before the United States entered the European War, the various refineries, which had up to that time been on two shifts, changed to three shifts. There is some dispute as to which company went first, whether the Standard Oil or one of the Gulf "independents." The change was made, however, primarily out of deference to general principle, because it was conceived that the eight-hour shift was the right thing and would be better from the labor standpoint. At the time the change was made wage-rates were rising and the men were given as much for eight hours as they had previously received for twelve hours. While the companies did not expect to operate so cheaply as on two shifts, there was some expectation that on a shorter day the men would do better. But this change was made at the beginning of the War, when labor conditions were continually getting worse, so that it was not possible to trace much improvement. Some noted, however, that whereas under the two-shift system the men had been negligent about their work at night, under the three-shift system this situation was improved. On the whole the companies think that in the long run the men do better work with the shorter shift, especially those having direct responsibility for the quality of the product.

With the wage reductions of 1921 there has been some tendency to lengthen hours on day-work. At a Philadelphia refinery the only request to work twelve hours had come from some of the laboratory men, who were engaged on routine sample testing. This request was not pressed nor granted. In spite of the idea at one time held that a man should be on duty twenty-four hours, the refineries have no serious difficulty arising out of the assignment of three men to the same task in twenty-four hours.

About one-third of the employees in a refinery investigated were on shift-work.

These general conclusions are based on inquiries in New York, Philadelphia, Pittsburgh and Texas, including both large and small companies, "independents" and the Standard Oil group.

The production of oil, as distinguished from refining, is not in all cases on three shifts. Pipe lines, except in rare instances, are on three shifts. The drilling of oil wells is on two shifts, except in Texas and possibly California. In Texas, oil-well drilling was first on two twelve-hour shifts; then on three eight-hour shifts; then, in a part of the Texas field, on two shifts of ten hours each. The pumping of oil in the field is day-work.

The apparent reasons for leaving drilling on twelve-hour shifts when all other phases of oil production and refining are on a different basis are:

1. The fact that a considerable part of the work is done by contractors who determine with the men their own working conditions.
2. The intensely active spirit which pervades the oil fields and which results in rush work and long hours.
3. The fact that the conditions are so different from those of manufacturing that the movement towards eight-hour shifts in manufacturing has little influence.

COTTONSEED OIL

There are two branches of the cottonseed oil industry: The cottonseed crushers scattered throughout the cotton belt and the oil refineries located in the North.

Cottonseed Crushing.

Crushing is the most important branch of the industry from the labor standpoint. There are from seven hundred and fifty to eight hundred mills in which cottonseed oil is made.

The main processes in a crusher consist in the linting and cracking of the seed, shaking out, rolling into fine flakes, and cooking the meal, and pressing the resulting "cake" to obtain the crude oil.

The equipment in the industry has been enormously over-expanded, so that, though a cottonseed crusher could run the year round, and should run for eight months in order to get satisfactory costs, the equipment in mills is such that an ordinary crop of seed could be crushed in ninety days. The mills controlled by large companies often run for eight or even nine months. Others run for only thirty to sixty days.

The proportion of the men on shift-work in this industry is unusually large. One company employing about 5,000 men reported that in a plant employing two hundred and twenty about one hundred and ninety are on twelve-hour shifts. Another leading company states that the proportion of shift-workers is near 100 per cent.

The extreme shortness of the operating season (for the majority of plants) is an influence towards two-shift operation. Another factor is that most of the labor is colored. According to the management of one company operating many plants, the colored employees constitute 90 or 95 per cent. of the total force. One plant investigated had only five white men out of more than one hundred employees. But whether for these or other reasons, there are few if any industries so universally on two shifts. So far as could be learned no crusher, unless it might be in Texas, is on three shifts. During the last season, which was slack, a few plants

have tried daytime operation only, but it is thought that this would be unsatisfactory as a permanent proposition.

Even where there are day-workers, they may also be on twelve-hour shifts. In a plant employing about one hundred men, the cake mill, employing six men, operated daytime only. Also on day work were two linter-saw sharpeners, one linter-man, one oiler, and one man responsible for local deliveries, eleven besides the irregular force of unloaders. Nevertheless every man in the plant, both of the shift and day-workers, was, with the exception of the man who made local deliveries, on a twelve-hour day.

It is sometimes said in explanation of the twelve-hour shift in cottonseed crushers that the work is not hard except in the press room, and that the presses, which must be filled about once in twelve minutes, may be filled by a good crew in considerably less time than that, thus giving a rest period before it is necessary to start again with the handling of the meal cake.

In view of the experience of companies in other industries with putting colored or seasonal labor on eight-hour shifts, it would seem that these factors are not so important in keeping cottonseed crushing on two shifts as might at first thought appear. The investigator believes that the extent of twelve-hour work is more a habit than a condition inherent in the industries or the type of labor. If that is so, then the question of two-shift versus three-shift operation will ultimately be as much an open question in cottonseed crushing as in any other continuous industry.

Cottonseed Oil Refining.

The amount of labor required in refining is small, compared to that needed in crushing, and much of the work is done in the daytime. The refining goes on in part, however, through the night, and then there are night employees in

the boiler and engine rooms. Of late there has been a tendency to put these fireroom and engine room employees on three shifts. Those who must work in the refining departments at night may be on two shifts, but they are few in number.

The Procter & Gamble cottonseed oil refining plant operates under the five-shift system described in Chapter IX. (See page 126.)

LINSEED AND OTHER VEGETABLE OILS

Linseed crushing and refining are carried on in the same plants, located chiefly in Minneapolis, Buffalo and near New York City. The number of employees in the whole industry is small and those on night duty, particularly on refining processes, exceedingly small, not more than a few men to keep watch over processes. In the West these men are on three shifts; in the neighborhood of New York City they are on two shifts. The engine room employees are on two shifts in all three localities.

Other vegetable oils are refined, probably more or less by continuous processes, by the same general groups of companies which refine cottonseed and linseed oil. The industries, however, are small.

CHAPTER XI

PAPER, FLOUR, RUBBER, MISCELLANEOUS MANUFACTURES, MINES

THE PAPER AND PULP INDUSTRY LARGELY CONTINUOUS

Of the industries which operate continuously mainly for mechanical reasons, paper manufacturing is the most important.

The total number of wage earners in the "paper and wood pulp" industry, according to the Census of Manufactures of 1919, was 114,000. The industry is in the main very solidly continuous in operation. Shift-work may begin with the cutting of logs into chips. It includes all the departments actually manufacturing pulp or paper. It may or may not extend to special finishing operations performed on paper after it comes from the paper machines. In some paper mills the only employees not on shift-work are the mechanics on repair work. One mill investigated employed five hundred and fifty-two men, four hundred and sixty on shift-work and only ninety-two on day-work. The number on shift-work in two other plants was one hundred and twenty-one out of a total of two hundred and seven workers in the one case, and four hundred and fifty-five out of a total of six hundred and fifty-five in the other.

In some sections of the paper industry shift-work is less general as the management has succeeded in arranging more of the work on a nine- or ten-hour basis. This is disclosed by a study made in the mills of Massachusetts in the fall of

1912.¹ It was found that of the 13,000 employees in the paper and wood pulp industry in that state, 30 per cent. were on shift-work, 68 per cent. were on day-work, about half on nine hours and about half on ten hours, and approximately 2 per cent. were employed on some arrangement not specified. It is not known why the number of shift-workers in Massachusetts should be as low as 30 per cent.²

On the Whole a Three-Shift Industry.

The pulp and paper industry is mostly on three shifts (or tours as they are called in the industry), although the industry still contains a number of two-shift plants. Of the shift-workers in the mills of Massachusetts, 30 per cent. were, in 1912, on twelve-hour shifts, and 70 per cent. on eight-hour shifts. In the next two years, six Massachusetts mills changed to three shifts, not a large enough change, however, to affect materially the proportion of twelve-hour workers.

The Census of Manufactures for 1914 showed that about 16,500 of the 88,000 wage-earners in the paper industry were in plants where the prevailing hours of labor were seventy-two hours a week or over.³ This figure is far from accurate even for that date, as it does not include paper plants where, as in Massachusetts, less than half of the employees are on shift-work. A study of the hours of 6,379 individual employees in paper plants, both day-workers and shift-workers, made in 1919 by the Bureau of Labor Statistics,⁴ showed that 7 per cent. of the number worked twelve hours. In 1921,

¹ Massachusetts Labor Bulletin No. 103 "Wages and hours of labor in the paper and wood pulp industry."

² The low percentage of shift-workers in Massachusetts paper mills may be because most of the mills manufacture fine paper, with a high percentage of employees in the finishing rooms.

³ The 1919 census tabulations do not show the number of seventy-two hour workers. But the figures for plants working "over sixty" hours indicate that the number of seventy-two-hour workers had been greatly reduced.

⁴ U. S. Bureau of Labor Statistics, Bulletin No. 265 "Industrial survey in selected industries in the United States, 1919."

one of the large associations of paper manufacturers, having about one hundred and twenty-five members in several branches of paper making, reported that about 20 per cent. of its member plants were on two shifts.

Varying Practice in Different Sections.

This figure is not to be taken as representative of the entire industry, as the practice varies in different branches of the industry and in different localities. The making of tissue paper is to a considerable extent on two shifts. The newsprint paper plants are on three shifts generally, if not universally. In general, the large paper-making centers, New England and Kalamazoo, Michigan, are on the three-shift system. In smaller paper mill centers the two-shift operation still prevails in many instances.

There is a wide variation of practice in some districts. For example, in Philadelphia there are no mills on two shifts, yet some are found in Wilmington. The mills in the Miami Valley south of Dayton are on three shifts, while north of Cincinnati they are mainly on two shifts. Only three-shift mills could be found in Kalamazoo. The few mills in Minneapolis are on two shifts. On the whole, however, the paper industry is on three shifts. It appears that not over 10 or 15 per cent. of the industry is on two-shift operation.

The question of shift systems in the paper industry has roused considerable interest. Mr. Robert B. Wolf has prepared a report on the changing of three plants from two to three shifts,⁵ giving:

1. Figures on manning scales.
2. Quantity and quality of production.
3. Labor cost.

⁵Printed in the Bulletin of the Taylor Society, February, 1921, as part of discussion on the Three-Shift System in the Steel Industry.

4. Other data showing the advantage of three-shift over the two-shift system.

It contains ample proof of the increased efficiency which can be gained in the paper industry by going to three shifts.

While Mr. Wolf states that the improvement was in part due to mechanical betterments and in part to the stimulated interest of the men in their work, he is confident that the improvements realized would not have been attained had the companies continued to operate on the two-shift system.

The evidence collected indicates, however, that gains as outstanding as those described by Mr. Wolf are not to be expected if divorced from the effort to bring out the interest and efficiency of the men, which distinguished the introduction of the three-shift system in the plants which he described.

An unusual situation exists in a southwestern Ohio paper company which has two plants under one roof, one of the plants on two-shift operation and the other on three-shift operation. The hourly wage-rates are fixed regardless of whether the length of the day is twelve or eight hours, so that the men in the twelve-hour plant earn 50 per cent. more than the men in the eight-hour plant. This condition has existed for some time without friction. There is enough difference between the type of mills and the work in the two plants so that the men could not easily change back and forth between the two. In the one plant the men prefer eight-hour work and in the other twelve. The management reports no difference in the efficiency of the men in the two plants.

Further evidence as to the wide variation in the results obtained by different organizations may be noted in the Massachusetts report on "Wages and Hours of Labor in the Paper and Wood Pulp Industry." In this report, the manning scales of the six paper mills which changed from two to three shifts between 1912 and 1914 are given before and

after the change. The per cent. increase in pay rolls ascribed to the change in shift systems varied from .2 and .9 per cent. increase, respectively, for the two companies having the best records, to 26.8 and 17.7 per cent. increase, respectively, for the two companies having the poorest records. That the increase in wage cost was on the whole moderate is indicated by the fact that the two companies which occupied the medium position increased their respective pay rolls only 4.2 and 5.7 per cent. In the case of at least four of the six companies, the increase in wage costs was so moderate that they might easily have been offset by a small increase in efficiency.

In the paper industry, more than in some others, there is a disadvantage in three-shift operation growing out of the necessity of three changes in personnel a day. This applies especially to such work as requires fine adjustment of equipment and special attention to uniformity of composition, color, etc., and where plants make many batches of special paper.

The attitude of labor in the industry towards three-shift operation depends considerably on whether the men are organized or are in localities where the unions have exerted little influence. In the former case they are usually much more desirous of going to an eight-hour shift. On the whole the employees are strongly in favor of the three-shift system and would be very much opposed to going back to two shifts. It was stated, indeed, that but for the three-shift system enterprising young men would shun the paper industry.

FLOUR A THREE-SHIFT INDUSTRY

Practically all of the large flour mills in the large centers are on three shifts. In the large milling centers, those plants which had not previously gone to three shifts, did so during

the War. Country mills or those located in small towns usually run by day only. Those located in the West went to an eight-hour day during the War. In the last year or two some of these have gone back to ten hours. Small mills in the East run a single shift of ten hours. In some of the cities of the East are to be found mills operating twelve-hour shifts. At Chattanooga is a mill which operates a twelve-hour shift even when operations are confined to daytime.

The Minneapolis mills set the pace by adopting three shifts in 1902 or 1903. Although for a time some employees were retained on nine or ten-hour work, the eight-hour day became universal in the Minneapolis mills about April, 1918, and the mills now operate on a six-day week.

In fact, what the Minneapolis managers have been giving most thought to in recent years (as respects hours) has been the question of the eight-hour versus the ten-hour day for those men who, prior to 1918, were on ten hours. This includes roustabouts, packers, millwrights, sweepers, etc. The change from ten to eight hours in these departments seems to have worked well. In the Washburn-Crosby Mills the flour packers did as much in eight as in ten hours. Under the ten-hour day they had really worked only nine hours. Even in the nine hours that they did work, there was an unwritten law covering the number of barrels which constituted a day's packing. The men were asked if they would do as much in eight hours as in ten. They said that they would, and they did. In some of the mechanical departments, as for instance the millwrights, where the day's task was less definite, the management found it necessary to add to the number of men. The increase in personnel was not large, and might be partly accounted for by an increase in the volume of work.

The shift men at the Washburn-Crosby Mills are rotated once a month, but the roustabouts and packers who are on shifts do not rotate. The management believes that it gets

a better type of labor because of being on the eight-hour day, and that accidents are less frequent.

Three-Shift Operation Profitable.

The Minneapolis experience with three shifts is of interest because:

1. It shows the effect of three-shift operation over a period of twenty years.
2. During much of this period the Minneapolis mills were in competition with important mills which were still operating on twelve-hour shifts.

It was difficult, indeed, to ascertain definitely the effects of the change from two shifts to three in Minneapolis because it was made previous to the incumbency of many of those now managing the mills. A former head miller stated that the cost of production was somewhat higher after the change, but that the men worked better. In certain mills where there had been four men on each shift or eight altogether, three were sufficient on three shifts or a total of nine. In his judgment what had seemed an extravagant thing to do proved to be an efficient procedure.

The result of the long experience with three shifts in Minneapolis has been to establish the system firmly.

A mill superintendent of Philadelphia, a man of long experience, stated that there is no question but that flour mills can operate on three shifts with financial profit. This is easy if the two-shift mill has been badly run and if the going to three shifts is a part of a campaign of putting the mill on a business-like basis. Thus shortly after the armistice a mill was changed from two to three shifts with a reduction in the total number of employees from about thirty-three to twenty-six, and an increase in daily output of

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25 per cent. The details of the manning scale on two shifts and three shifts follow:

TABLE 9

COMPARATIVE MANNING SCALES OF FLOUR MILL, TWO-SHIFT SYSTEM AND THREE-SHIFT SYSTEM

(A case of unusual gain, due in part to more than usually poor organization while under the twelve-hour system)

Occupation	Manning scale on two shifts.		Manning scale on three shifts.	
	Distribution	No.	Distribution	No.
Millers.....	1 on a shift.....	2	1 on a shift.....	3
Oilers.....	1 on each shift, extra in daytime.....	3	1 on each shift.....	3
Sweepers.....	Distribution not specified.....	3	1 on each shift	3
Packers and roustabouts...	5 packers and 1 trucker on each shift, 9 day loaders.....	21	3 packers and 2 loaders on each shift.	15
Elevators.....	Daytime only.....	4	Daytime only.....	2
	Total.....	33	Total.....	26

Although this mill was not up to standard in efficiency when on a twelve-hour day, yet the data show some interesting facts:

1. The greater proportionate increase in the number of those in a supervisory capacity, as millers.
2. A general improvement of the organization after changing to three shifts, bringing savings in day-work as well as in shift-work. The suggestion is

that the twelve-hour shift may be accompanied by laxity even in the day-work.

3. In spite of the reduction in the number of men an increase in the output of the plant from seven hundred and seventy-five to nine hundred barrels per twenty-four hours.

The above is an extreme example. A better illustration is a Louisville mill, which was put on three shifts about 1913. In this mill three shifts were operated with no larger force of men than had been used on two shifts, the number being about one hundred and fifty before and about one hundred and fifty after the change. But it was stated that the output was increased by 100,000 barrels per year, or 30 per cent. This reduced the manufacturing cost about 35 per cent.

The gains are not limited to savings in manning or to increase in the volume of material handled. An important gain is made in conserving and increasing the percentage of flour which is obtained from the wheat. The Philadelphia mill superintendent above referred to said that if milling methods are not what they should be, a part of the flour in the grains of wheat is lost and goes into the feed. In the milling of flour, the grain is "broken" several times and the flour sifted out, sorted as it were, and made to flow through such channels and to such mills as will save as much of the flour as possible. By rearranging the mill flow and by special care on the part of the millers the proportion of the flour saved can be increased.

The savings in manning, the increase in the capacity of a mill, and the conservation of flour are largely due to the planning of the management. But it is held that these changes cannot be brought to the highest effectiveness unless millers and men cooperate; and they cooperate much better on eight hours than on twelve.

RUBBER

Every reply to an inquiry regarding the rubber industry was to the effect that there is now no twelve-hour shift in the industry.

Before the rise in importance of the automobile tire, rubber plants rarely worked at night. The industry was then centered in Massachusetts. But when a plant did operate nights, it was on eleven and thirteen-hour shifts. Upon the development of the rubber tire, the length of time required for vulcanizing, which in the early days was four or five hours, together with the rapid expansion of the business, caused a distinct increase in the amount of continuous-operation, especially as respects vulcanizing. There was, accordingly, a considerable period, lasting in Akron until 1916, in which the eleven and thirteen-hour shifts were an important feature in a rubber plant. Following the adoption of the three-shift system in 1916, and prior to the depression in the industry a year ago, the unprecedented activity of the industry caused a general adoption of continuous-operation in tire manufacture. Generally the equipment came to be run continuously on a three-shift basis.

Since the depression in the industry there has been a marked difference of opinion regarding the permanence or the advisability of continuous-operation. Technically, it is not so important since the vulcanizing process has been reduced in time from four or five hours to about one and a half hours. Some hold that it was only the abnormal production and rapid expansion of the industry which brought about continuous-operation, and that there is no technical reason why the industry should stay on continuous-operation. Others say that in view of the expensive equipment and the rapidity with which it becomes obsolete it should be operated to its full capacity during its life. The vulcanizing process, more-

over, invites continuous-operation, though not so insistently as the heat process in many industries. At present there is an overexpansion of equipment in the industry, so that it is likely that the pressure of circumstances will cause an abandonment of continuous-operation. However, many of the elements are present which in other industries have led and still lead to a large measure of continuous-operation.

At the time of writing, 1922, owing to abnormal conditions in the industry, the working schedules of the Akron plants are arranged in many different and exceptional ways. There is no indication as to what the permanent outcome will be. Temporarily the Goodrich Rubber Company has changed from three eight-hour shifts to two shifts totaling twenty-one hours, the day-shift being ten hours and the night-shift eleven. During the other three hours the plant is idle. The day-shift works five and a half days a week—fifty-five hours in all; and the night shift five nights a week—likewise fifty-five hours in all. To say that the company was on ten and eleven-hour shifts without further qualifications would be misleading, not only because the eleven-hour shift is only run five nights, but because work is so slack that the men do not work the full fifty-five-hour week. For the time being, fifty-five hours is the standard, but it is not the actual practice.

The principal change, which was in the length of the working day, has carried with it a new arrangement of several other details as respects shifts. Under the three eight-hour shift system, the plant operated from 12 Sunday midnight to 11 A. M. Saturday. The company experienced difficulty due to the fact that men on the Saturday afternoon shift would not report for work. Under the present arrangement there is no Saturday afternoon shift. Under the former system, the men ate during working hours. Now the two shifts are each split around a half-hour lunch period, so that

the plant is closed down, aside from these lunch periods, for two hours. One of the reasons, it should be stated, why the ten and eleven hour arrangement was adopted was because it would help on the housing shortage until such time as the situation should be relieved.

The management finds that the showing of the ten and eleven-hour arrangement has been more profitable both to the management and the men than the eight-hour arrangement. The special circumstances noted above must, however, be taken into account, also the fact that the comparison was between an eight-hour shift system operated when the labor situation was unfavorable, the turnover large, and housing inadequate, and a ten-hour shift system operated when these conditions were reversed.

In recent years there has been no rotation of shifts in the Goodrich plant. In the early days shifts did rotate. The company thinks that from the standpoint of fixed habits of the men it is better not to rotate. The men like the fixed shifts better. The older men get the day shift. When the company was on three shifts, the men disliked most the shift from 11 P. M. to 7 A. M., but the greatest loss of efficiency was on the shift from 3 P. M. to 11 P. M. because of the irregularity of attendance on Saturday afternoons. The Goodrich plant does not employ women at night, as do some of the other Akron plants, but during the War there was a departure from this practice, and it was found that many women preferred the night shift. The power plant, which runs seven days a week, is still on eight hours.

The movement to a fifty-five hour week for Goodrich shift workers is part of a larger movement from an eight-hour day to a fifty-five hour week for day-workers. In the manufacture of tires, 65 per cent. of the employees are on shift-work, but as tire manufacture constitutes only about one-third of the Goodrich plant, and the rest of the plant does not

have night-work, only about one-fifth of the total enrollment of employees are on shift-work. It should again be noted that the present plan is one adopted for the present situation, and the management does not regard it as necessarily permanent. Other concerns at Akron are working on different basis, some on eight-hour shifts. It is said that none have adopted twelve-hour shifts.

BREAKFAST FOODS

The manufacture of breakfast foods is largely an automatic process. In the manufacture of corn flakes, for instance, the initial stages are analogous to milling. The second stage is cooking, the third, rolling the cooked grains into flakes. The flakes are then passed through ovens and toasted, and packed into cartons. Throughout these operations the product is carried by chutes, on belts or otherwise conveyed. The cartons are machine filled. The industry is primarily a machine industry, the greatest need for labor being in connection with the packing, where women are employed. If a plant makes its own cartons, they are manufactured on day-work, or on two shifts totaling less than twenty-four hours. But all the processing of the product is continuous.

The preparation of cereal foods is usually on three shifts. Of the two leading concerns at Battle Creek, Michigan, one has women employees on three shifts, men on two shifts; the other is operating three shifts as respects both men and women.

The plant on three shifts adopted the plan about 1910. Three-shift operation is uniformly applied in all the departments which actually handle the product from the mills that work on the corn to the packing. The power plant is also on three shifts. The unloading of corn is on a ten-hour day.

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The mechanical men are mostly on a single eight-hour shift, but the machine shop runs three eight-hour shifts. The printing of the paper stock for cartons is on two eight-hour shifts, or on three eight-hour shifts depending upon the season.

The understanding between the board of directors and the management of the plant was that the product was to cost no more than when on two shifts. The effort to keep within the limit of costs was successful. In changing to three shifts, the management called the foremen together and obtained their suggestions. Jobs were eliminated wherever possible. The employees as a rule did not get such high earnings per day on three shifts but received more per hour, the largest cut in daily wages being one-sixth. In some cases employees earned more on eight hours than they had earned on twelve.

The effect of three shifts on cost was not uniform in all departments. In the producing departments, three shifts were made to pay. The work of some groups of employees, such as engineers, and general overhead labor, costs more. One department where success in keeping down cost was greatest was the boiler room. The company allotted the amount it could afford to pay in wages, and the boiler room was left to work out its own manning schedule.

BAKERIES

The arrangement of work periods in bakeries varies widely.

In a large Philadelphia bakery the only employees whose working hours were definitely fixed were those in the power plant, the watchmen, and, to a degree, the drivers. Not all the mixing or all the baking was done at the same time, and because of the fluctuation in the demand for bread even the men who had regular assignments of work had no definite

hours. The day for mixers and bakers ranged from seven to nine hours, an ordinary run being forty-five to forty-eight hours. The only employees on three shifts were the power plant men and the watchmen.

The only employees of this bakery who worked long turns were the drivers, who worked from about midnight to about noon the next day—sometimes as much as thirteen hours. The drivers worked on commission and largely ran their own business; their working time depended on the size of the trade, the nature of the route—whether city or suburban—and doubtless on the despatch with which they worked. The company tried, however, to limit the routes to ten hours.

The practice in this bakery is thought to represent the practice throughout Philadelphia.

In Chicago baking has been on three eight-hour shifts for many years, all the stages of bread making proceeding throughout the twenty-four hours. There is no baking, however, on Saturday. The three shifts at a plant investigated were about equal in respect to the number of men employed, and included practically all employees. At the time of making the study, business was slack, partly because of a protracted strike and some plants were only running two eight-hour shifts. The drivers in Chicago have no regular hours, some of the men covering their routes in eight hours, others taking twelve hours.

In the state of Ohio, twelve of the two hundred and eighty-seven bakeries reporting to the Industrial Commission in 1915 gave their full-time working week as seventy-two hours or over. By 1919, this proportion had been reduced to two bakeries out of four hundred and three. Such statistics as are available indicate a tendency towards longer hours, on the part of certain groups of bakery employees, than are common in the strictly non-continuous industries.

SAW MILLS

Saw mills are ordinarily operated during the day only, or on two eight-hour or two ten-hour shifts. However, a few years ago two of the largest saw mills in the country, one in Louisiana, and the other in the Northwest, were operating on three eight-hour shifts.

INDUSTRIES WHICH FLUCTUATE BETWEEN CONTINUOUS-
AND NON-CONTINUOUS OPERATION

The industries grouped under this classification are not necessarily continuous, and as a rule do not operate continuously. At times, however, either commercial conditions or the advantages of an increase in operating time as applied to heavy equipment may cause them to operate day and night.

In general the fabricating as opposed to the processing industries run by day only. The ordinary manufacturing industries: machine shops, furniture factories, clothing shops, shoe shops and plants manufacturing electrical goods, locomotives, typewriters and the construction industry are definitely daytime industries. During rush periods, however, there is some night-work, and in a few of the more heavily equipped of these industries there is a growing tendency to favor sixteen-hour or twenty-four-hour operation as a continuous or recurrent arrangement.

Automobiles.

The clearest illustration of this tendency is the automobile industry of Detroit. Most of the large automobile manufacturers of Detroit operate on two eight-hour shifts. The largest, the Ford plant, operates on a combination of two eight-hour and three eight-hour shifts.

The Ford policy is to change this department or that from two to three shifts, or from three to two shifts (of eight hours

each) as required to keep the capacity of the plant adjusted to the demand for automobiles. In October, 1921, only about 20 per cent. of the departments were on three shifts, but sometimes as high as 75 per cent. are on that basis. No women or children are employed on any but the day-shift. Watchmen, like other employees, are on eight-hour shifts. The plant runs either five or six days a week, and shifts are rotated once every two weeks, thus making a complete round in six weeks.

The practice among the other larger plants is to operate on a day shift of about nine hours for five-and-a-half days or fifty hours per week. The night shift is ten hours for five nights—likewise fifty hours per week. The smaller factories run twelve hours at night for five nights or sixty hours a week. Their day-shift would be less than twelve hours, thus leaving some interval between the day and night work.

Shipbuilding.

Shipyards run in the daytime only, except when making rush repairs, and contemplate no change. Watchmen, of course, must be employed at night. The largest shipyard on the Delaware River, employing one hundred and eighty watchmen, works them on three eight-hour shifts.

Textiles.

Textile manufacturing is a daytime industry. But night operation is a common practice, especially when business is good. A few textile mills located in the North have run on three shifts. There is no special advantage in making the day and night shifts continuous. Commonly there is one day shift and one night shift, which together work somewhat less than twenty-four hours.

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In Georgia, the mills frequently run nights, but not for more than sixty hours a week. The state law forbids a week of longer than sixty hours for any shift in this industry. The custom is to run only five nights of twelve hours each. A day-shift of sixty hours is based on an eleven-hour day, as the mills run only half a day on Saturday. A minority of the Georgia mills, which turn out, however, more than half of the product, have adopted a fifty-five hour week on day-work. The managements believe that the employees will do as much in ten as in eleven hours. A twelve-hour night shift and an eleven-hour day shift give practically continuous-operation on a two-shift basis, for the six days and five nights which the plant runs.

The textile mills in the Carolinas operate on much the same arrangement as in Georgia.

In the North, night work is common, but there is considerable variation in the length of the shifts. This is partly due to state laws regulating the hours of women, which in effect determine the hours worked by the men. One company having mills in several states operates a forty-eight hour week in Massachusetts, a fifty-four hour week in Rhode Island, and a fifty-five hour week in Connecticut. Often the number of hours in any one working day is longer than the number of hours worked per week divided by six, because of a Saturday half-holiday, or because of working only five nights. The company mentioned runs its plants six nights, which gives shifts of about eight or nine hours.

A company operating in New York State reports that about half of its 1,000 to 1,200 employees are on shifts, continuous-operation being the ordinary practice throughout the year. This company during 1918-19-20 ran its yarn mill on three eight-hour shifts. The department is now (1922) on one ten-hour shift (fifty-four hours a week), and one twelve-hour shift (sixty hours a week). The spinning room,

wash houses, etc., are on one ten-hour and one twelve-hour shift. The finishing room, where only women are employed, is on a single shift of ten hours (fifty-four a week). This company has not employed women at night, except on the evening eight-hour shift when the yarn mill was on that basis.

In Pennsylvania some of the silk mills have departments operating on two twelve-hour shifts. At a large bleachery in Delaware, employing about 1,300 persons, four or five departments sometimes run at night, when the plant is busy. About three hundred employees are then on shifts, the day-shift running from 7 A. M. to 5:30 P. M. and the night-shift from 5:30 P. M. to 7 A. M.

BORDER-LINE INDUSTRIES

Slaughtering.

Meat packing is not a continuous-operation industry. Because of the great fluctuations in the number of head of stock brought to the market on different days, there are rush days and slack days. This situation was recognized in a decision made in 1921 by Judge Alschuler, then acting as arbiter for the Chicago packing industry, which permitted the operation of the plants slightly over eight hours (the standard day) on several days a week. Were there no rules or precedents it is possible that in this industry long hours might alternate with short hours. But the packers are not disposed to start an extra shift for such limited periods as the rush work occupies.

Power plants are the only important part of a packing establishment to require continuous attention. Before 1921 they had been on two twelve-hour shifts, but for them also the Alschuler awards established an eight-hour day. Watchmen are still on two twelve-hour shifts. Aside from men in the

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power plants and watchmen, there are a few men on continuous work in charge of tanks. These men were put on eight-hour shifts by the arbitration awards.

East of Chicago the Alschuler awards did not apply and some of the power plants may be on twelve-hour shifts.

Canning.

The canning of vegetables brings a fluctuating demand for labor. When weather conditions bring in a huge crop of tomatoes all at once, the canneries are taxed to their utmost capacity, and work almost any length of hours for a short period. The canning establishments do not, so far as learned, run an extra shift. They cannot run two shifts or three shifts because they lack the supervising personnel. One leading concern reported that there had been occasions during the tomato season when a small group would work through the entire twenty-four hours, but this was exceptional. Their maximum working day, under ordinary rush conditions, is fifteen hours, and ordinarily it is only nine hours.

Creameries.

No systematic study of creameries has been made. No concerns were found to have run continuously, except as regards the men responsible for power and refrigeration. Statistics for hours in creameries indicate that the working week is longer than in many other industries, but this is due in part to a seven-day week.

MINES—TUNNELING

The main operation in mining need not be continuous, but to a large extent they are run on more than one shift. There is no day or night under ground, and the mines must be pumped and kept in operating condition. Hence the tendency towards shift-operation.

In odd cases, mines may be run on twelve-hour shifts as was found to be true of clay mines in Florida, but this is exceptional. The main work of mining differs from the supervisory type of work which is characteristic of the continuous industries, in that it involves a large proportion of heavy manual labor. The loss in efficiency on twelve-hour shifts would, therefore, be much more obvious. This nature of the work, together with the lack of special reason for continuous-operation and the influence of trade unions, has fixed the workday of the miner at about eight hours.

In some instances mines are operated on two shifts of about eight hours each. The work on the two shifts may be different—cutting and blasting on one shift, and loading on the other; or the work of the second shift may consist of tunnelling and other work incidental to keeping the mines clear. In other mines two eight-hour shifts of the same kind of work are run, and sometimes three eight-hour shifts. The latter is the practice in copper mining in the West. Two shifts (of eight hours) are more common than three.

There are, however, auxiliary occupations in mines which necessarily are continuous, such as those of engineers, firemen and pumpmen. In metal mines these men are mainly on eight-hour shifts.

In the union and some of the non-union mines in the bituminous coal fields of Pennsylvania, engineers, firemen, and perhaps pumpmen work on eight-hour shifts. That two shifts for this class of employees in bituminous mines is not uncommon is indicated, however, by statistics collected in 1919 by the Bureau of Labor Statistics,⁶ which show a scattering of twelve-hour men among employees in these three occupations. In some localities, the twelve-hour men formed a considerable proportion of the total, as in Oklahoma, which

⁶U. S. Bureau of Labor Statistics, Bulletin No. 265, "Industrial survey in selected industries in the United States, 1919."

had seven twelve-hour pumpmen out of fifteen, and twelve twelve-hour engineers out of seventeen; and in Indiana, which had twenty twelve-hour firemen out of thirty. In other states, including Pennsylvania, the proportions were smaller.

In the anthracite field, the twelve-hour shift is almost universal for pumpmen. An operator knew of no mine which had its pumpmen on three shifts. The figures collected by the Bureau of Labor Statistics in 1919 showed that more than 71 per cent. of the pumpmen in the anthracite field averaged twelve hours a day or over. Engineers and firemen were some years ago put on eight-hour shifts and there are few on the two-shift system at the present time.

The sentiment of the anthracite operators is different in respect to engineers and firemen on the one hand, and pumpmen on the other. The former classes of employees work hard, and the eight-hour shift, the operators think, is not unreasonable. But the pumpmen have little to do except turn a valve now and then. The pumpman is probably a retired miner who wants a steady but not too difficult job. He wants to make what money he can for his family and is said not to mind the hours. So the operators, though they sympathize with the idea of putting engineers and firemen on three shifts, think that to put pumpmen on that system would be unreasonable. This distinction did not, however, strike the bituminous operators as important, many of whom have gone ahead and put their pumpmen on three shifts.

In tunneling, which presents much the same problem as mining, two eight-hour shifts are used. In the construction of the Catskill aqueduct, however, the work of excavating was continuous in both headings from each shaft. There were two eight-hour drilling shifts, with a four-hour mucking period after each.

CHAPTER XII

ELECTRICITY, GAS, WATER, ICE

Factory Power Plants.

THERE is an increasing tendency for factories to buy rather than to generate electric current. While most of the establishments investigated develop their own power, thirty-six out of eighty-six cement plants from which data were collected purchase power.

A power plant is more or less continuous even in the case of those industries which are not continuously operated. But the number of workers at night is less than by day. Moreover, it is possible to arrange overlapping shifts which will provide more men during the period when work is active and fewer when it is inactive, without any of the men being on exactly twelve-hour or eight-hour shifts. This means that night men may often be on duty for twelve hours, or even more, but the possibilities of arrangement are flexible, and there is a wider choice of working periods than is permissible in power houses or other factory departments whose main processes run continuously and where the only practical alternative is between the twelve-hour and the eight-hour shift.

The power departments of plants which operate continuously present much the same problem in shift arrangement as exists in the production departments of those industries. In general, power plants in factories have been run on twelve-hour shifts down to the last few years. At present there is a strong tendency to put engineers and firemen, in

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common with other continuous-operation employees, on three shifts. In some of the continuous industries there is a stronger tendency to put engineer and boiler room employees on three shifts than process men, who may not have much manual work to do. In other instances, especially where mechanical stokers are used, the men in the power departments have been thought less deserving of an eight-hour shift than other employees. But since boiler and engine rooms usually run continuously, if any factory department does, and may run twenty-four hours when almost no other departments do, the actual number of twelve-hour employees among engineers and firemen has been large. Generally in a two-shift plant they are on two shifts, and they often work two shifts of twelve hours when most other men in the plant work only ten hours.

It is hard to make a general statement as to the possibility of attaining greater efficiency or reducing manning schedules in changing engine and boiler rooms from two- to three-shift operation. In some cases it has been difficult to make a reduction in the number of men required, in other cases there has been a material reduction in personnel per shift.

Table 10 shows the reductions in the manning scale effected in the power plant of the Midvale Steel Company when that department changed to three shifts in 1914. The management had said that three shifts could be put into effect if no additional men had to be hired. The men accepted this condition with the agreement that they were to receive the same wages for eight hours as they had been receiving for twelve. While the number of employees varied from month to month, the figures shown in the table represent average conditions with the plant running at nearly full capacity.

There was some increase in total manning and hence total pay roll in changing to three shifts, but the increase was not

more than 8 per cent. The smallness of the increase was due to the cooperation of the men with the management, the men working harder, especially in No. 1 boiler house, which was hand-fired. When the plant was speeded up during the War the men were unable to handle the work. Before the War was over, there were as many men on the eight-hour shifts as there had been on the twelve-hour shifts.

TABLE 10

COMPARATIVE MANNING SCALES, TWO-SHIFT AND THREE-SHIFT SYSTEMS. POWER PLANT, MIDVALE STEEL COMPANY

	No. 1 boiler house	No. 2 boiler house	No. 3 boiler house	Power house	Total
Two-shift system:					
Day shift.....	14	12	8	5	39
Night shift.....	12	10	6	5	33
Total two shifts.....	26	22	14	10	72
Three-shift system:					
"A" shift.....	10	9	6	4	29
"B" shift.....	9	8	5	4	26
"C" shift.....	8	7	5	3	23
Total three shifts.....	27	24	16	11	78

Engineers and Firemen in Office Buildings, Hotels, etc.

There are many small power or heating and refrigerating plants in office buildings, hotels, etc., which require the services of engineers and firemen. Formerly these men were on twelve-hour shifts. During the War the twelve-hour shift practice for this class of employee seems to have been eliminated. Information from widely separated cities indi-

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cates that these men are now generally working on three shifts, or some arrangement other than two shifts.

Public Service Electric Plants.

This investigation showed that practically no central electric stations are at present operating on twelve-hour shifts. In most cases the abandonment of the two-shift system took place many years ago. In 1915 only thirty-two of the ninety-two electric light and power plants in Ohio reported a full-time working week of seventy-two hours or more. By 1919, there were only six such plants out of ninety-eight. In many of the larger cities the change to three-shift operation was made ten to twenty years ago, and for a number of years past the plants remaining on two-shift operation have been of only minor importance.

It was found that an important power company in Alabama operated its steam plant for three months a year on twelve-hour shifts. In its hydro-electric plant, the men worked twelve hours at night and eight hours by day, the maintenance men doing shift duty for four hours.

The investigator found only the one two-shift company during the course of this study. A table showing the results of an extensive analysis of the hours of employees in various electric plants scattered over the country, which had been compiled by electric interests, showed no employees working twelve hours except a few in one plant located in Arkansas. In general it may be said that the generation of electricity in central electric stations is on three shifts, except that here and there a few substation men are on twelve-hour shifts.

Electric plants have been on three shifts for so many years that no comparison can be made of the relative cost and efficiency of two-shift and three-shift operation. The question is all the more difficult because there have been radical

changes in equipment and methods since the two-shift system has been abolished.

Nevertheless, it is important to know whether the eight-hour shift is an advantage or disadvantage to the industry. In general, the electric companies report that when they changed to three shifts they added about 50 per cent. more men. Whether better efficiency was attained is a question answered in different ways.

The operating head of a large Pittsburgh station declared that public utility companies would not consider twelve-hour operation, because having gone more carefully into the question of efficient generation of power than was true of factory power plants, they knew that it was impossible to get from men working twelve hours a day the rigid adherence to high standards of operation essential to maximum economy.

A Cincinnati electric company abolished the twelve-hour day eight years ago. At first they changed to ten hours, then to nine hours, and five or six years ago to eight hours. This plant operates at an exceptionally high thermal efficiency. This is due largely to the plant construction and equipment, but there has also been developed an extensive program of technical education for the employees. Because of the eight-hour shift and the educational program made possible by the shorter working day, the company obtains employees of a better type than formerly.

The management of the Philadelphia Electric Company states that the number of employees on shift-work was increased by 50 per cent. in the original change to three-shift operation. But since that time the equipment has become more complex and is now combined in larger units, the work of the men is now more diversified and the standard of operation has been raised. Because of these conditions the superintendent is of the opinion that the men could not maintain for twelve hours the quality of work they are doing on an

eight-hour shift. This he thought would be especially true during the summer months. It is his further judgment that, if the plant should now go back to twelve-hour shifts, almost as many men would be needed as are now employed on eight-hour shifts, but that the men would not be willing to go back even if they were paid as much per hour for twelve hours as for eight.

The Philadelphia Electric Company recently reduced the working week from seven to six days, with results so satisfactory to both management and men that neither would favor a return to the longer week. The spirit of the organization has improved under the new plan, and only one-tenth instead of one-sixth more men are needed for its operation.

In electric plants while nearly all the main operating departments are on shift-work, such activities as handling coal and doing repair work are not on a shift basis. In one plant 50 per cent. of the men were on shift-work and 50 per cent. on day-work. Day-workers are often employed for nine or ten hours, but in practically all cases shift-work is now on an eight-hour basis.

GAS

In the gas industry the proportion of shift-workers is rather large. There has been, in places, a retention of the system of nine- or ten-hour overlapping shifts. The chief center in which the ten-hour shift, in conjunction with the eight-hour shift is still employed, is Philadelphia and outlying localities in the same operating system. Also the twelve-hour shift was long retained in those gas plants employing colored labor. Richmond, Virginia, was on twelve-hour shifts until the late War; a leading Georgia company until 1919, and several of the larger cities in Tennessee are still on twelve-hour shifts. A large city in Indiana was on twelve-hour shifts until about six years ago.

The managers of gas plants differ in opinion as to the effect of changing to three-shift operation. In New York City the gas plants abandoned twelve hours some time ago and more recently changed from a nine- to an eight-hour basis, arranging day-work also on eight-hour schedules. The eight-hour system is regarded as more satisfactory than the nine-hour system. At the municipally operated plant in Richmond the men do as much in eight as formerly in twelve hours. The management maintains that the new arrangement is an improvement from the standpoint of the city's interests.

The Georgia plant which changed in 1919 found that the general spirit and reliability of its employees, part colored and part white, was improved. There was possibly some saving in materials and upkeep. However, 50 per cent. more men were required for shift-work at the time of change. At present the operating crew is no larger under three shifts than it had been under two, which is due in large measure to improved machinery. Output was not affected by the change. The men prefer three shifts, but there has been no improvement as to absenteeism and labor turnover.

The superintendent of the Indiana plant reported that there was little difference in the efficiency of the men on twelve-hour and eight-hour shifts. In either case the men were given a definite amount of work to do in a given time; there was a rest period between the pushing of hot ovens. Under the eight-hour system, it was unnecessary to carry extra men to take the place of regular men who were absent. Some men were always willing to work an extra shift, or sixteen hours, and could do so easily. On the other hand, there was difficulty under the eight-hour system in getting good foremen for the wages offered. The better men preferred the longer hours on account of the higher pay. Colored labor preferred the shorter hours, the better class of Slavs

the long hours. This company has been contemplating returning to twelve-hour shifts.

A Colorado company found that three shifts required more men than two shifts. There was no noticeable increase in output, and it was questionable whether quality had improved. No improvement in the case of equipment or reduction in wastes had occurred. The changing to three shifts had reduced labor turnover and absenteeism. The management stated that both the company and the men were satisfied with the three-shift plan.

Conditions in Philadelphia Plant.

The manufacture of gas in Philadelphia illustrates the workings of the ten-hour shift arrangement. There are not more than about thirty-five twelve-hour men. These are employed in the seven holder stations, with five men each—one in charge and four on definite twelve-hour shifts. A few watchmen may be on twelve-hour shifts. But these twelve-hour shift holder station employees, together with watchmen who may be on the same hours, are insignificant in number compared with the 1,300 employees of the gas works proper.

When the city operated the gas works in 1897, it is said that practically all the men worked twelve hours. When the operation of the works was placed in private hands the new management reduced the day from twelve to ten hours. The company also arranged for the men to have one day off per week—if they chose. Some of the groups of men, however, for example the engineers and firemen, usually work seven days a week.

Some years ago the management entertained the idea of changing to eight-hour shifts and a six-day week, but as the men were not interested, the ten-hour shift was retained. However, the practice is not uniform in all departments.

Manufactured gas is of two varieties, coal gas and water gas. The manufacture of coal gas formerly required much shoveling and is still somewhat hotter and more difficult than the making of water gas. Several of the jobs in the Philadelphia works making coal gas are on three eight-hour shifts. The floormen, who formerly shoveled coal, the charging and discharging machine men and the coke men work eight hours. The foremen, the coal conveyor and bulling machine men and the engineers are on ten-hour shifts. Most of the men in the retort house work thirteen days and then have a day off. Some have one day off in seven. The engineers have no regular days off.

In making water gas, the continuous work is on ten-hour shifts. Foremen and gas makers work six days only, but all others, including engineers, firemen, water tenders, coal passers, clinkerers and filter men, work seven days a week.

The distillation plant, wherein are produced coal tar by-products, is on three shifts. The men work ten hours a day, seven days a week. The still men may go home when their work is finished, which may be at the end of seven, eight or nine hours. Clerks work nine hours. The testing stations are on three eight-hour shifts.

Several expedients are used in Philadelphia in providing for ten-hour shift operation while maintaining a continuous twenty-four-hour schedule.

1. Under one arrangement, five engineers man two jobs. Two work ten hours each on one of the jobs; two work ten hours each on the other job and the fifth man works four hours on one and four hours on the other job. He then completes his turn by working two hours at repair work in another engine room.
2. According to another plan, three engineers work on the same job ten hours each so as to give two over-

laps of one hour each during which two engineers are on the job, and one overlap of four hours.

8. According to another plan the men come on duty every two hours and work for ten hours. By having twelve men working under this arrangement, an even five would be on duty during every part of the day.

These examples show the possibility of changing from twelve-hour to ten-hour shifts where it is considered inadvisable to shorten the shifts to eight hours.

WATER SUPPLY

Water-works plants must operate continuously. The labor required, however, is less than in the case of any other public utility—the pumping of water for New York City requiring only 339 shift-workers and forty-seven day men. The water-works plants of Richmond, Atlanta and Birmingham require the services of about sixteen, forty-five and twenty-four shift-workers respectively.

Most water-works plants are on eight-hour shifts. However, in four southern cities in which inquiries were made two operated their plants on twelve-hour shifts. One of these is a municipal and the other a private plant. The third plant had changed from two to three shifts about 1918. The fourth had been on three shifts for a number of years.

In the instance of the municipal plant, the men were really operating under a system of twenty-four hours on and twenty-four hours off, the works being located a little out from town and the men preferring that arrangement, apparently for reasons of transportation.

In 1915, four of the sixteen Ohio water works reporting to the Industrial Commission reported a full-time working

week of seventy-two hours or over. By 1919 this had been reduced to one plant out of twenty-three.

ICE, ICE CREAM, REFRIGERATION

Until recently the manufacture of ice has been one of the most completely two-shift industries in the country, both in the proportion of shift employees in any given plant, and in the proportion of plants on a twelve-hour basis. During the War three-shift operation gained headway in the East, particularly in the case of the large companies supplying the chief seaboard cities. One company having plants in Boston, Philadelphia, Atlantic City, Baltimore and Washington changed to three shifts at that time. Today most of the large city ice companies in both East and West are on a three-shift basis.

But there is still a large volume of twelve-hour work in the industry, particularly among the smaller plants and in small towns. As examples:

1. Small companies in Philadelphia and all the plants in Richmond,¹ Atlanta, Birmingham and Chattanooga operate on a twelve-hour basis.
2. The 1919 Census of Manufactures shows that the great majority of wage-earners engaged in ice manufacture throughout the South and a substantial proportion of those in the North are in plants where the hours of labor are over sixty hours per week.
3. All the regular ice plants in Pittsburgh are on twelve-hour shifts.
4. In Ohio, as late as 1919, twenty out of the one hundred companies reporting to the state authorities gave

¹ In Richmond engineers and firemen are on eight-hour shifts in the summer months and ice pullers engaged in the manufacture of ice from aerated as opposed to distilled water are on ten-hour shifts.

their full-time working week as seventy-two hours or over. In 1915 the proportion had been forty-seven plants out of seventy.

In ice plants practically all the work is on a shift basis. The engineers and firemen must be on shift-work. The ice pullers usually are on shift-work. However, the latter often finish their work in ten hours instead of twelve, or in seven-and-a-half hours instead of eight. In a few cases ice pulling is arranged on a single shift.

The manufacture of ice is highly seasonal. The plants are rather dormant during the winter and occasionally work only one shift. It is not uncommon for plants to operate three eight-hour shifts in the summer and two twelve-hour shifts in the winter.

Opinions regarding the relative efficiency of the two-shift and three-shift operation of ice plants vary. The men in actual charge of plants state that three-shift operation is advantageous.

At the plant of a large company in Philadelphia the change from twelve- to eight-hour shifts was made—without changing the hourly wage rate—because it was difficult to get men to work twelve hours. The increase in the number of shift-workers was nearly 50 per cent. Table 11, which shows the manning schedules both old and new, well illustrates the difficulty of saving in manning in a small plant.

The problem of twenty-four hour operation exists in ice-cream plants, cold-storage plants, dairies or other places where refrigeration is necessary. In Pittsburgh, where the ice companies are all on two shifts, the largest ice-cream company has been on three shifts for about fifteen years. The chief engineer of this company said that he would not want to change to two shifts. During the years which the company has operated its power department on three shifts, the

plant has grown so that even on eight-hour shifts the work is almost too heavy to handle.

TABLE 11

COMPARATIVE MANNING SCALES, TWO-SHIFT AND THREE-SHIFT SYSTEMS:
A PHILADELPHIA ICE PLANT

Occupation	Number employed on two shifts	Number employed on three shifts
Engineers.....	2	3
Oilers.....	2	3
Firemen.....	2	3
Coal passers.....	2	3
Ice pullers.....	8	11
Handymen.....	1	1
Extra labor.....	1	1
Total.....	18	25

A comparison of the situation in this plant with that in the small Philadelphia plant already described suggests that the possibility of introducing an eight-hour shift into ice making without loss depends in no small measure on the building of larger and more improved equipment, into which a man may be able to put substantially as much labor and usefulness in eight hours as he could put into the old style equipment in twelve hours.

CHAPTER XIII

TRANSPORTATION, COMMUNICATION, CARE-TAKING, PERSONAL SERVICE

TRANSPORTATION

Ocean, Lake and River Vessels.

THE length of the shift in the shipping industry is important from an international as well as a domestic standpoint. In this industry competition between nations is pronounced. Therefore, unsatisfactory labor requirements might seriously interfere with the shipping industry of the country in which they exist. Therefore, it is especially important that the facts regarding the operation of the American merchant marine and the foreign merchant marines be understood.

The crews of vessels may be divided into licensed deck and engine officers, unlicensed deck and engine crews, and employees of the steward's department. All but the last named department are primarily continuous-service departments. The work of the stewards extends over a large part of the day, but the duties are so arranged that each employee works not more than about ten hours.

The minimum number of licensed deck and engine officers on an American vessel is fixed by law or by the Steamboat Inspection Service. Practically no ocean-going vessel of consequence is allowed to sail without three deck officers and three engineers, in addition to the master and chief engineer. This means that so far as officers are concerned the laws and regulations prescribe the three-watch system. However, the watches are not eight hours but are four hours on and eight

hours off. The evening or dog watches are a succession of two two-hour watches which result in the men being on a different watch each day.

The laws applying to the Great Lakes are not so stringent as those for the ocean. Many lake vessels carry only two assistant engineers. In fact, a third assistant engineer is an exception. If the chief engineer does not stand watch that means a two-watch system for lake engineers. Also on ocean-going towboats, of which there are a considerable number employed in the coal trade from Norfolk north, there are practically never more than two engineers, including the chief. That means a two-watch system also. However, as towboats are in port a great deal, at which time the crew has little to do, a two-watch system is not a cause for grievance. On the Gulf coast, where the towboats are larger, engineers are on three watches. Engineers on steamboats on interior rivers are on two watches. But the boats are not large and the duties are not heavy. The marine engineers' union does not regard the two-watch system on ocean-going towboats or river boats as objectionable. The union is opposed to the two-watch system for engineers on the Great Lakes.

The ocean-going vessels of foreign nations have their licensed officers on three watches. British vessels are apt to carry more rather than fewer officers than American vessels.

The unlicensed crew on American vessels, composed of firemen, oilers, water tenders, and coal passers,¹ are on a three-watch system by law. This is also the general practice on vessels of foreign nations. Because of the heat and hard work the three-watch system for these men is accepted as a proper arrangement.

It is with respect to the deck crew or the sailors that the issue of a two-watch versus a three-watch system arises. The traditional method of organizing the deck crew was by the

¹Coal passers not included in the laws.

watch-and-watch system. The sailors were divided into two squads who relieved each other at regular intervals, ordinarily four hours apart throughout the day and night. With the advent of the steamship there developed a tendency to put as many of the deck crew as possible on day-work, leaving only the two positions of helmsman and lookout to be filled at night. This mixed system, half day-work and half a watch system, is known as the Kalashi watch system.

Ship owners in this country generally prefer the Kalashi watch system, as it means more men at work in the daytime, when conditions are favorable for working. The sailors prefer it because they like to work by day and sleep by night. The general movement in this country has consequently been in the direction of the adoption of this system. England, however, operates its shipping on the watch-and-watch system.²

Prior to the War, sailors on American vessels sailing from Atlantic or Gulf ports were on the watch-and-watch system, which gave a total of twelve hours of watch duty a day.³ This was in accord with the general practice among all nations except in the cases of France, Australia and New Zealand, whose vessels were on three watches. On the Pacific Coast a three-watch system prevailed for such members of the deck crew as were not on day duty only. In 1919, the Pacific Coast plan was adopted by ship owners and seamen on the Atlantic and Gulf. By the terms of this agreement three men were to perform the duties of helmsmen, three the duties of lookout, and the rest were to work eight hours

² Arguments against the Kalashi watch system are that it means a minimum of men on duty at night. In case of emergency the men must rush on deck with their eyes as yet unaccustomed to the darkness. The system, furthermore, has the disadvantage of keeping a part of the sailors, the day-workers, continually on less skilled work, and thus hindering that all-around development of skill on the part of all members of the crew which would result if all the men were to take turns at positions connected with the actual navigation of the vessel.

³ The Kalashi watch system had already become common.

a day. During favorable weather the lookout was to do some deck work in the daytime.

Largely because of this last provision, the three-watch system was put into effect without change in total manning. It was claimed that the system, except on the smaller ships, would mean no increase in the number of sailors. The manning schedules for Shipping Board vessels did require an increase, but the increase was much less than 50 per cent. The marine superintendent of one of the large and successful American shipping companies reported that in the case of this company no increase in manning resulted from changing to three watches, but there was less work done while at sea and more left to be done when in port.

The mixed system of three watches and day work was one of the terms of settlement of the marine strike in 1919. The men lost the marine strike in 1921 and one of the results was the annulment of the agreement respecting three watches. The company referred to above now has its day men on nine hours instead of eight and the two-watch system is reestablished for helmsman and lookout. Although the three-watch system had not increased the size of the crew the return to two watches and nine-hour day work reduced the deck crew from eleven to ten men. Although the total force was cut by one man, the number of men assigned to upkeep and repair work was increased by one. This fact, together with the lengthening of the work day from eight to nine hours increased by one-fourth the amount of labor available for repairs. The lengthening of hours described applied to freight ships. At the time, the three-watch system was retained on passenger ships, but of late there has been further development in the direction of two watches.

The three-watch system was never established for sailors by the principal carriers on the Great Lakes. The two-watch system has been the rule.

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Radio operators on American vessels are on a two-watch system. However, the radio operator does not have a great deal to do. On many vessels there is only one operator.

The changes made during the last few years from two to three watches and from three watches back to two have affected only a few men aboard any one ship. Out of a total crew of about forty sailors only six were affected by the change to the three-watch system and four by the return to the two-watch system.

The tendency on the seas is towards three watches. Italy and France are said to have their deck departments on that basis, and England has been tending that way. Some of the American union leaders are not eager for three watches, but the sailors strongly favor it.

In recent years there has been little difference between the manning scales on American and foreign vessels. In some cases the British have larger crews. Nor do American vessels operate under a handicap in the matter of food and wages. The food on many European vessels will compare favorably with that on American vessels. There is today very little difference in the wages of unlicensed men. Licensed officers receive considerably more on American vessels. But wages usually do not amount to 10 per cent. of the cost of operating a ship. The question of watches is after all of subordinate importance. The needs are:

1. The development of skilled, resourceful management.
2. The establishment of such conditions as will secure a high type of seamen.

Longshoremen.

The loading and unloading of ships can be profitably done by day and night. It is advisable to use both day and night in order that the ships may quickly start on the return

journey. But continuous loading and unloading is handicapped by excessive wage differentials for work done after 5 P. M. and before 7 A. M. Continuous operation is further impaired by the retention of a very inadequate and obsolete employment system. Men are reemployed every day, sometimes twice a day. This produces either a surplus or a scarcity of labor at different points. It increases the number of men needed in the business. Notwithstanding these conditions many of the leading steamship companies believe that it pays to load continuously. Irregular and long hours are followed by periods of no work.

Fishing.

Fishing vessels work unlimited hours during the fishing season. This is inherent in the nature of the business and cannot be easily remedied.

Steam Railroads.

In a sense the railroads constitute one of the largest continuous-industries. But the situation is different in so many respects from ordinary continuous-industries, that it is better to think of them simply as containing elements of continuous-operation.

Trains move day and night but the train movement is broken up into runs. The equipment may be operated either more or less than twenty-four hours. The hours of duty of the crews may be equal to or fractions or multiples of the train runs, having no necessary relationship to twenty-four hours.⁴ Freight train crews are supposed to be on duty ten

⁴ Reference is made here not to the law, but to the idea with regard to the length of runs in the mind of railroad managements at the time of the laying out of division points. Subsequent changes in conditions, such as the lengthening of trains have, however, so affected running time as to lead to great diversity in actual hours of duty.

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hours, but because of delays, they may be on duty sixteen hours. Twelve hours is not uncommon. The runs of crews on passenger trains are more regular and shorter as regards time.

The Adamson Act made the nominal hours of service eight, but there was a physical difficulty in making the actual hours come to this basis as the distance between terminals had been designed for ten-hour runs. Little has been done under the eight-hour law in changing the hours actually worked by train service employees, except that since the passage of the Adamson Act, the railroads have constantly endeavored to eliminate delays and improve service, thus reducing the length of time on each run.

The average hours of duty of train service employees of the New York Central Railroad during the year 1920 were as follows:

	Freight service	Passenger service
Engineers	3166 hours	2500 hours
Conductors	3200 hours	2700 hours
Trainmen	3300 hours	2400 hours

The average is under ten hours per day. Counting three hundred days to a year (for the purpose of making comparison with other industries), men on freight trains worked the equivalent of ten-and-a-half to eleven hours a day; those on passenger trains from eight to nine hours. The railroad managements state that men prefer the longer runs, which of course, bring the larger pay. The managements consulted thought that there was no connection between the length of run and accidents.

The really continuous work of a railroad is the maintenance of the railroad equipment and service by:

Telegraphers
Stationmen
Switchmen
Crossing guards, and
Roundhouse men.

By legal enactment telegraphers who handle messages covering the movement of trains have been on eight-hour shifts since 1907. Dispatch offices and signal towers are usually operated continuously and on three shifts.

The more important railroad stations are open twenty-four hours a day. These are on three eight-hour shifts. Stations open part of the day, if the period is long enough for two shifts, operate on two eight-hour shifts. Small stations are served by one man which necessitates his being on duty longer than eight hours, sometimes twelve hours. A twelve-hour day, however, is rare. A decision of the Railroad Labor Board, January, 1922, restored the nine-hour day for railroad clerks, freight handlers, and express and station employees. The award also permitted the establishment of split tricks. This will have an important influence on hours where the station is open for less than twenty-four hours.

On one of the leading East and West lines prior to 1917 switchmen were on twelve-hour shifts. Since that date they have been on eight-hour shifts. According to the management of a leading western road the yard crews of that road are on three shifts in the large terminals. Outlying points sometimes have only one crew. The aim is to confine the hours of the crew to eight; but sometimes, where there is only one crew they work ten, eleven, or twelve hours.

In most cases crossing men were on twelve hours, but under the Railroad Administration they were put on eight-

hour shifts and have remained on that basis except in a few cases where they are on nine hours. Some crossings are not guarded twenty-four hours and some not a multiple of eight hours. In such cases, and in cases where there are nine-hour shifts the men are changed from one crossing to another. Occasionally where only one man is needed during the day he is on duty ten or eleven hours.

Roundhouse men were formerly on two twelve-hour or two ten-hour shifts. They are now on three eight-hour shifts.

The change from twelve to eight hours for switching gangs, crossing men, roundhouse men and other classes is the result of legislation or administrative rulings effected during the last five years. At first, with these as with the trainmen, the eight-hour day was a basis used in determining when overtime should begin. But in time the railroads proceeded vigorously to place all the men they could on eight hours so as to escape overtime pay.

The change from a basic to an actual eight-hour day has been well received by the employees, notwithstanding the fact that it meant more than a pro rata reduction in pay.

As to the management, though the change to three shifts did not in itself increase expenses, because of the reduction in the earnings of employees, yet the increase in wages which occurred in the same general period focused the attention of railroad managers on the desirability of dispensing with labor wherever possible.

Railway shops operate one eight-hour shift. During busy seasons two eight-hour shifts are employed. In periods of great demand they operate on three eight-hour shifts.

Street Railways.

The work of conductors and motormen on street railways is not continuous, although it is distributed over a long day. The runs for an individual employee range from eight to

eleven-and-a-half hours in length, averaging not much more than nine hours. This is true even in those sections of the country where the twelve-hour day is common. In case of split runs, there is usually a maximum spread which is not apt to be over fourteen hours.

COMMUNICATION

Telegraph Companies.

The telegraph industry offers no example of long hours, unless it might be in some subordinate branches of the service, or the special telegraphic services maintained by private business organizations.

The Western Union land lines and cable system employ about 52,000 men and women, the men constituting 70 per cent. of the total force. In May, 1917, the Western Union land lines changed from a system under which the night tricks had been seven-and-a-half hours and the day tricks nine hours to an eight-hour day. Not all of its operators change shifts at the same hour. They are taken on and off at such hours as will correlate the number of operators with the demand for telegraph service. In a few cases employees work on split tricks.

The Western Union cable service also observes the eight-hour day. In the smaller land line offices, where the work is usually performed by one operator, the tour of duty may be as long as ten hours. In such cases the work of the operator consists chiefly in "readiness to serve" as the work of the entire day can be done within an hour of steady application. As the time required to go to and from work is usually very short in the small towns, the longer hours of duty do not give the employee any less time at home than in the case of the city worker.

The management believes that the eight-hour shift has

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been advantageous both to the company and to the employees. Overtime and Sunday work are kept at a minimum, as undesirable from every point of view. The company has provided recreation rooms for its women employees, thus enabling them to use their leisure hours to advantage.

Telephone Companies.

The Bell Telephone system has no long shifts. As in the case of the Western Union, its operators do not all change shifts at the same hours, but are taken on and off at such hours as will correlate the number of operators with the demand for telephone service. The force after midnight is about 7 or 8 per cent. of the total.

The usual arrangement is for an operator to serve from seven to eight hours per shift. In case of split tricks the trick is so divided as to give the operator sufficient time off to be of use to him. The night shift is on the exchange from 10 in the evening (9 P. M. in some cities) until 7 in the morning. But each operator has a one- or two-hour lunch period part of which many operators use for naps. An object in arranging the night work in this manner is to make it unnecessary for operators to go to and from work late at night.

Of the 220,000 regular employees of the Bell system, 133,000 are in the traffic department and 60,000 in the plant department. Of the traffic employees 116,000 are female operating employees in the central offices.

The employees in the plant department of the Bell system are engaged in both construction and maintenance work. The men who are employed outside of the central office exchanges are on regular day time assignments, except in emergencies (storms, etc.). The maintenance of the central offices involves some continuous service, but the number of men employed at night is relatively small. Employment beyond the regular day shifts is for the most part in late evening shifts which

end before midnight. From midnight until the morning shift the number of plant employees on duty is practically negligible (only caretakers and in the large exchanges a few held for emergency). Central office men are in practically all cases on eight-hour shifts, coming and going at such hours as will best take care of the peak loads.

The practice described for the traffic and maintenance divisions is followed in both the large and small exchanges of the Bell system in all parts of the country. Among the "independents" who have a proportionately greater number of rural lines, there may be exchanges which work longer hours. That long hours have existed is indicated by the fact that of three hundred and forty telegraph and telephone companies which reported to the Ohio Industrial Commission in 1915, fourteen reported a working week of seventy-two hours or over. By 1919 this number had been reduced to one company out of three hundred and sixty.

The Postal Service.

The mail carrier works by day only. In the evening there is a small force of collectors (often substitutes or auxiliaries who do not come under the law regulating the hours of post office employees), but they are usually on duty for only a few hours.

The distribution of the mails in city offices is a continuous operation. In 1921, there were in the United States about 54,000 post-office clerks of whom approximately three-fourths were engaged in the distribution of mail. The eight-hour law of 1912 limits the hours of a post-office clerk to eight with a maximum spread of ten hours. The shifts of the clerks are so arranged that there is more or less overlapping at certain hours. The shifts do not rotate, except in a few offices where there is a local custom to that effect.

Most of the distributing clerks in a city office change

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shifts at approximately midnight, 8 A. M. and 4 P. M. As the heaviest work is between 5 and 9 P. M. the largest number of clerks is on duty at that time. Out of two hundred clerks, it would be found that:

1. From 110 to 125 clerks are on duty from 4 P. M. to midnight.
2. From 18 to 20 clerks on duty from midnight to 8 A. M.
3. From 65 to 70 clerks on duty from 8 A. M. to 4 P. M.

In addition to the regular distributing clerks a force of auxiliary workers often works four hours during the evening. These men may be employed elsewhere during the day. Sometimes they are men who have not yet been admitted to the civil service.⁵ They give flexibility to the force and take care of the evening peak load.

The motor vehicle corps is bound by the rule of eight hours within ten. The arrangement of hours varies with the locality.

Although before 1912 no law regulated the hours of post-office employees, the working time was usually about eight hours. An employee of more than twenty years' experience in the service did not know of a time when there had been twelve-hour shifts.

The railway mail service maintains in cities terminal railway post offices which are distinct from the city offices, and where the work is more evenly continuous throughout the day and night. The terminal railway post-office clerks, about 3,000 in number, fall roughly into three groups. They work respectively between midnight and 8 A. M.; between 8 A. M. and 4 P. M.; and 4 P. M. and midnight.

⁵ This is true only when there are no eligibles on the civil service register. When available, all auxiliaries or substitutes must be employed from the civil service eligible list.

The men who transfer the mails from place to place are on the same shift basis as are the mail clerks.

There are about 14,000 or 15,000 railway mail clerks who sort mail on the trains. The hours of these men are not fixed by law, except that they must not work more than the equivalent of three hundred and six days of eight hours each per year, including, as noted below, the time necessary for study.

The working hours are arranged on many different plans, in accordance with train schedules and length of trips. In general, each clerk works for about a week, during which he is on the road most of the time. He is then off for perhaps a week. The total time of a one-way trip is apt to be ten or twelve hours. It may be as much as fourteen or sixteen hours. The clerk has considerable studying to do, which can be done between tours or on his run, between towns, and for which he is given credit.

If the route and train schedules are such that the mail clerk can repeat his first day's trip on the third and again on the fifth day, and his second day's return trip on the fourth and again on the sixth day, then two crews working simultaneously can man the route. As two other crews would be required during the week the first two crews are off, this would make a four-crew route. Routes vary so much that there are also five-crew and three-crew routes. There are even two-crew and single-crew routes, as well as those requiring six and even seven crews. In former times there were some nine-crew routes.

The Express Service.

The American Railway Express Company has about 115,000 employees, most of them on day-work. The collection of express stops at 5 P. M. and offices close at 6 P. M.

At large terminals the work is continuous throughout the twenty-four hours. In December of 1921 these employees

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were on an eight-hour day. Prior to the War they had been on nine or ten hours, but first, overtime was established for work over eight hours, and then the eight-hour day was installed in most cases. The volume of work at the terminals is less at night than in the daytime. The men come on at various hours of the day, the arrangement of hours varying according to the train schedules.

There is no doubt in the minds of either men or management but that express employees like an eight-hour day.

The express companies have messengers who travel on the trains. Their hours are arranged somewhat like those of the regular train crews, or of the railway mail clerks.

CARE-TAKING

Police Department.

The policing of our cities is among the largest of the continuous-industries or activities. New York City has 11,000 men on its police force. Of this number 9,000 are on service that is continuous throughout the twenty-four hours.

Some years ago, police departments in American cities were generally on the two-platoon system. This involved twelve-hour shifts in some of the cities, but it did not result in an average daily service of twelve hours. By having a reduced force a part of the day, the average number of hours of service of the individual policeman was below twelve hours. In Richmond, Virginia, the day was divided into four six-hour periods, two at night and two in the daytime. Each policeman served one six-hour shift every night. The day shifts were provided for by having that one-half of the men who had been on the first night shift divided into two divisions each of which served six hours during the day. By this arrangement just one-half as many men were on duty during the day as during the night. The plan made it possible for

each policeman to be off duty every other day, though always serving half of the night.

One of the chief objections to the two-platoon system as worked in Richmond was that those men who had been on duty the six hours from 7 P. M. to 1 A. M., and were in the half that had to serve the next day from 7 A. M. to 1 P. M. had only six hours off. If they were delayed in making reports and getting home, they had only a short interval for rest in a period of patrol service extending practically over eighteen hours.

This same system of six-hour shifts with every other day off during the daytime, was formerly used in New York City, except that the hours of changing squads were 6 P. M., midnight, 6 A. M. and noon.

The two-platoon system has been abandoned in all the cities concerning which inquiries were made. In some cities, an effort is still made to enlarge the police force during certain hours of the day, but this is usually accomplished by having three nine-hour or three ten-hour shifts, so arranged that the overlap comes when the extra protection is desired. Thus Pittsburgh is on a three nine-hour platoon system with two platoons on duty between 9 and 12 P. M. In New York the number of officers on patrol duty is now constant throughout the twenty-four hours. The patrols change at midnight, 8 A. M. and 4 P. M.

New York operates under a ten-squad system, as shown by Table 12. The purpose in having ten squads, instead of nine, is to provide one day off in seven for the patrolmen. Under this system one of the ten squads is always taking an extra sixteen hours off. Of the nine squads not having a day off, three are always on duty simultaneously. Each day one of the three squads takes only four hours off and then reports for eight hours reserve duty, after which the men have four hours off before returning to patrol duty. Each squad thus

loses half its time off once every three days; but at such times, the men are held on reserve at the station house and, except in emergencies, may sleep. During a week each patrolman works six eight-hour shifts on patrol duty, and is on reserve duty two eight-hour shifts. After six days of service the patrolman is off a total of thirty-two hours. There is always one squad on reserve duty.

The police authorities consulted have been unanimous in their judgment that the eight-hour shift for patrolmen is better than the longer hours formerly worked. The Richmond authorities state that it works "one hundred per cent." better. It is the belief of the New York authorities that the two-platoon system with the daylight hours off every other day is not right for the men. Police authorities place a low value on a patrolman who serves much more than eight hours a day.

This does not mean that the authorities necessarily favor an eight-hour day for men who are not on shift duty. The traffic men in New York are on duty nine hours with an hour off during the day. Detectives usually work more than eight hours per day.

The twelve-hour day is to be found in the auxiliary service of some police departments. The park police in a Delaware city are on twelve-hour shifts.

Fire Department.

Fire departments formerly operated without any change of personnel except for a day off now and then and a few hours off for meals. Now they generally operate on the two-platoon system. The squad off duty is expected in case of fire to report so that they will be available in case of a second alarm. Under the two-platoon system the men take their meals on their own time, which eliminates a reduction of the force at such periods.

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If full protection is to be given, it is necessary to have larger crews under a two-platoon system than under the twenty-four hour system. Richmond added forty-two firemen (which made the new force consist of three hundred and twelve men) when it changed to two platoons in November, 1921. Formerly the men had one day off in three. Out of an engine company of twelve men, four would always be off. Of the other eight, one or two would perhaps be off for a meal, leaving six or seven at the fire stations. In adopting the two-platoon system it was only necessary to increase an engine crew of twelve to fourteen to insure seven men always being present.

Under the two-platoon system the day shift is usually shorter than the night shift. In New York the day men serve nine hours and the night men fifteen hours. In some other cities there is not so great a difference in the length of the shifts.

Some fire departments are run on a system of twenty-four hours on and twenty-four hours off. This is sometimes popular with the men, as it enables them to work elsewhere during their twenty-four hours off.

Cleveland for a time operated on a three-platoon system. In April, 1921, it changed back to two platoons, under a system of twenty-four hours on and twenty-four hours off.

Watchmen.

Watchmen, as a rule, are on twelve-hour shifts. This is true of three-shift plants as well as of two-shift plants.

Some companies have put their watchmen as well as all other employees on three shifts. Some of these have been noted. The New York Shipbuilding Company saw no reason for its one hundred and eighty watchmen working twelve-hour shifts when everyone else in its plant was on eight hours. Ford's watchmen are on eight hours. When the Washburn

Crosby Company changed its watchmen to eight-hour shifts they realized a more effective service. The shortening of shifts was regarded as an important factor that contributed to the improvement. An officer of this company held that a more vigorous type of man should be drawn into watch duty, younger men who would be able to cope with marauders.

The superintendent of a Philadelphia plant, whose watchmen were on twelve-hour shifts, thought it was a mistake. He held that watchmen perform as important a service as other employees.

An experienced fire insurance man in New York did not regard the twelve-hour watchman as a cause of increased fire risk. The insurance rules all contemplate twelve-hour shifts. Police officers, on the other hand, take quite a different view. They do not think that watchmen any more than policemen are going to be efficient on twelve-hour turns.

MISCELLANEOUS SERVICE

Hotels.

In the large and moderate sized hotels the hours of the employees are usually reasonable. The day force works ten hours or less.

The service of bellboys, elevator men, and hotel clerks must extend over a longer period. A frequently used device is a long day and a short day. That is one day the working hours are from 7 to 12 in the morning, and from 6 to 11 in the evening, or ten hours altogether, and the next day from noon to 6 P. M. or six hours.

The regular hours of waiters and others connected with the dining-room service in New York hotels are reasonable. But it is said that there is a good deal of overtime because of banquets which often necessitate long hours. There is no adequate provision for days off.

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Engineers and firemen in hotels work on from eight-hour to ten-hour shifts.

In small hotels, the situation is quite different. The investigation disclosed various small hotels where those in charge worked twelve-hour shifts. In 1919, about 10 per cent. of the three hundred hotels in Ohio reported that the full-time working week for their employees was seventy-two hours or over. In 1913, the union rules for hotel waiters in New York State called for twelve hours.

Hospitals.

Hospital work involves continuous service. In 1913, the union rules for Buffalo hospital employees specified eighty-four hours a week. A report made in 1921 by a hospital in Buffalo showed that nine-tenths of the employees were on two shifts. The other one-tenth, consisting of boiler and engine room labor, changed to three shifts during the War. Hospitals in other cities concerning which information was received were on twelve-hour shifts. However no special study has been made of hospitals.

Stables and Garages.

The care of horses has been the occasion for a considerable amount of twelve-hour shift-work. Ten per cent. of the Ohio companies engaged in "cartage (drayage) and storage, including livery stables" in 1915 reported a working week of seventy-two hours or over. In 1919, the proportion was fourteen companies out of three hundred and thirty-one. Stablemen for bakeries and other concerns engaged in retail delivery have often been on twelve-hour shifts. Statistics indicate that there is a certain amount of twelve-hour work about garages.

Delivery Men, Chauffeurs.

In Buffalo in 1913 the union rules for ice drivers, baggage transfer men, and chauffeurs called for a twelve-hour day.

Restaurants.

The hours of labor in most of the restaurants are short, because of the employment of women in large numbers, and the fact that the number of hours per day that women may work is in many states limited by law. However, in the typical restaurant long hours are not necessary. By arranging split tricks or shifts the day can easily be divided into work periods of moderate length.

In small restaurants open late at night, the employees are often on duty twelve hours. In Ohio, forty-seven of the one hundred and forty-eight restaurants reporting in 1915 gave their working week as seventy-two hours or over. In 1919, there were fifty-two out of a total of four hundred and seven. In many of these restaurants the seven-day week is associated with the twelve-hour day.

Retail Stores.

There are types of retail stores, as drug stores, soda fountains, and small shops which are open for twenty-four hours, or until late at night. There is less standardization of hours in this group than in any of the industries investigated. It would require a very detailed investigation to determine the proportion of employees on long and on short shifts. However, it is known that one or more of the men in these stores often work eleven or twelve hours per day, or even longer.

In 1915, out of 2,459 Ohio stores reporting to the Industrial Commission as to the hours of work per week, one hundred and thirteen reported a working week of seventy-two

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hours or over. In 1919 seventy stores out of 4,268 reported a seventy-two-hour week. The very small stores (employing less than five persons) do not report.

The 1913 rules for Buffalo unions specified a twelve-hour day for grocery store employees, meat cutters, and clothing salesmen.

Other Service.

Statistics indicate that there is some twelve-hour work among the employees of theaters, amusement parks, bowling alleys, barber shops, and undertaking establishments.

CHAPTER XIV

PROCEDURE IN CHANGING FROM TWO SHIFTS TO THREE

Points to Be Observed.

THE method followed in changing from two to three-shift operation is of the utmost importance. One of the outstanding facts developed by this survey has been the wide variation in the results that have followed the change from two to three shifts. This variation is more largely due to the methods followed than to other circumstances.¹

If greater efficiency is to result from changing from two to three-shift operation several cardinal points must be observed. They are:

1. Whether the men do more work per hour on an eight-hour shift than on a twelve-hour shift depends upon how they feel about the change. How they feel about it depends in considerable part upon the management's viewing things from the employees' standpoint and showing them how they will benefit by increasing their efficiency in return for shorter hours.
2. The management must plan so that the employees will have an opportunity to perform more and better service on the shorter shift. This involves setting

¹This subject is fully discussed in a separate monograph prepared by the present investigator entitled "The Technique of Changing from the Two-shift to the Three-shift system in the Steel Industry" proof sheets for which were issued in 1922 by the Cabot Fund Trustees. See also Mr. Bradley Stoughton's report in Part III of this volume.

definite schedules of work for each day; the establishment of high standards of performance for eight hours' work; the standardization of equipment and its maintenance; in short a close production control. These things done and cooperation obtained, favorable results are sure to follow.

3. The establishment of a permanent differential of 50 per cent. or thereabouts between the wages of shift- and of day-workers should be guarded against. Perhaps the most serious difficulty in changing from two to three shifts is the severity of the shock that it may give to individual incomes, or, if this is avoided, the increase in labor costs that may follow. It is only fair to make an adjustment in the wages of the twelve-hour shift-workers, but it should be done in such a way as not to establish a permanent vested interest in favor of one class of employees.
4. The time at which the change is to be made, and the method used as related to the special circumstances prevailing at the time are important factors.
 - a. When the general level of wages is advancing is an opportune time to change from a two- to a three-shift system, for then the shortening of hours can be made in lieu of wage advances. It may be possible to give the men as much for eight as for twelve hours' work, a part of this taking the place of a wage increase.
 - b. If the period is one of reduced employment, more men may be employed for shorter hours, or the same men given steadier employment for shorter hours. Thus the eight-hour shift may be attained without much cost, and without the men suffering more than they would have to any way, because of periods of unemployment.

- c. If the period is one of stable wages and employment, then the practicable thing to do is to make an effort to secure greater efficiency, and out of increased profits pay the men enough more per hour to make the change to shorter shifts an easy and satisfactory one.

In some plants or operations the efficiency has been high on the twelve-hour shift and sometimes it is difficult to introduce high standards for the eight-hour shift, but a faithful observance of the factors mentioned will mean substantial increase in efficiency. If they are not observed the results will be disappointing.

Hours for Day-Workers Associated with Shift-Workers.

This investigation has had to do with the twelve-hour versus the eight-hour shift and not the nine- or ten-hour versus the eight-hour day. However, the question may arise as to whether day-workers should be on an eight-hour day in line with the shift-workers, or on a nine- or ten-hour day. The investigation has shown that there is no difficulty in maintaining day-workers on nine or ten hours and shift-workers on eight hours, unless there is an objection to a nine- or ten-hour day in itself. The fact that shift-workers have been placed on eight hours does not of itself necessitate putting the day-workers on eight hours.

The Seven-Day Week.

On continuous work that must be maintained seven days a week the question arises as to whether three-shift workers should be relieved one day per week. When the length of the shift is eight hours the shift-workers have a shorter day than eight-hour day workers, since they take at least one meal period within their eight hours of duty. The system of rotating shifts is usually so arranged as to lengthen hours at some

week ends, and give the men longer time off at other week ends. By this means shift-workers are practically off duty one or two Sundays in three. Therefore, good argument can be advanced against introducing a six-day week on shift-work. As a rule the day off could not be on Sunday but on some week day. Many would prefer to work on the week day.

However, many of the continuous-industries are providing one day off in seven, although the men are on an eight-hour shift. As a rule the arrangement gives satisfaction. The companies are pleased with it. One of the steel companies, which is on two shifts but a six-day week, has found that its men have so adapted their habits to having a week-day off, that they now prefer a week-day to Sunday.

On the other hand, another steel company, when it changed from two to three shifts, at the request of its employees, adopted a seven-day week. Previously its practice was a six-day week.

Rotation of Shifts.

Many plants rotate shifts every week. Some believe that it would be better if the shifts were rotated every two weeks or a month, as the habits of the men would not be changed so often. Those plants that employ women extensively do not rotate shifts.

An advantage of the three-shift system on seven-day work is that it obviates the necessity of a twenty-four hour turn or two eighteen-hour turns when shifts rotate. Sometimes under the three-shift system one of the squads of men works a sixteen-hour turn. But there is no need of this. It is preferable to have part of the men report after an absence of only eight hours and serve a second eight-hour shift, rather than to have a sixteen-hour turn. There are innumerable arrangements which are possible, as two twelve-hour shifts, or even three turns of ten and two-thirds hours each.

CHAPTER XV

CONCLUSIONS

THIS concluding chapter is a summary discussion based upon the entire investigation. It presents through a series of questions and answers the problem of the twelve-hour shift in American industry.

1. What is the extent of continuous work in American industry?

There are upwards of forty continuous-industries operating more or less completely upon a shift-system. They employ between 500,000 and 1,000,000 wage-earners on shift-work. Their families constitute from 1,500,000 to 3,000,000 persons who are dependent upon earnings from shift-work.

There have been (prior to the late depression) probably 300,000 wage earners working on twelve-hour shifts. They and their families number more than 1,200,000 persons.

2. What are the alternatives to the twelve-hour shift?

The logical alternative to the two twelve-hour shift-system is the three eight-hour shift-system, and this is the usual procedure. Nevertheless other shift-systems have been resorted to in a limited way in changing from the twelve-hour shift. Among these are:

- a. Operation for a period shorter than twenty-four hours in each calendar day, the cessation of work

for from two to four hours permitting the establishment of two shifts of ten or eleven hours each.

As examples:

Rolling mills may run two ten-hour shifts. Tube mills run twenty-two hours out of twenty-four. Packing in flour mills is usually on two ten-hour shifts.

- b.* Arranging what is nominally a twelve-hour shift so that the actual work can be completed in ten or eleven hours. As examples:

Ice pullers sometimes finish their work in ten to eleven hours; firemen in brick and lime plants in eleven hours.

- c.* Arranging overlapping shifts, thus securing three nine-hour or three ten-hour shifts in twenty-four hours.

- d.* Arranging nine and ten-hour shifts on a five-shift plan. As an example—Procter & Gamble Company, Cincinnati, Ohio.

3. Are there technical difficulties in changing from two-shift operation?

In the overwhelming majority of the plants which have changed from two- to three-shift operation no technical difficulties have been encountered.

There is usually no relationship between the duration of the process and the length of the shift, whether the latter is twelve hours long or a shorter period.

In a very few industries such as making glass, burning brick, or making special grades of paper some managers (but by no means all) have believed that more uniform results can be obtained by having two instead of three men superintend the making of a batch or lot.

The seeming disadvantage of having three men instead of two responsible for a given product, or process, is overcome by standardizing procedure and establishing control through precision instruments.

It takes more careful management, however, to see that three men do not between them dodge the responsibility for the proper care of equipment.

4. What are the factors to be considered in changing from two-shift to three-shift operation?
 - a. The readiness or unreadiness of the men to do more work per hour under the shorter shift.
 - b. The responsibility of management as expressed in planning, supervision and control, which should be of a higher quality than usually prevails under two-shift operation.
 - c. The fluctuation in individual earnings and labor costs.
 - d. General industrial and economic conditions, as determining the time of making the change.
 - e. The relationship of work periods for shift-workers and for day-workers.
 - f. The relationship of wage-rates for shift-workers and for day-workers
 - g. The number of working days in a week.
 - h. The rotation of shifts.

5. How does the change from two-shift to three-shift operation affect the number of shift-workers?

It is not possible to give an inclusive answer to this question because of the variations in conditions. In many plants the number of shift-workers has increased in proportion to the increase in the number of shifts. In other plants the num-

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ber of shift-workers has remained substantially constant when changing from two-shift to three-shift operation.

The former outcome was common among plants which went to three shifts during the War, and it inevitably results when the management gives no thought to how three shifts will be run.

Under normal labor conditions most plants should be able to introduce a third shift by adding 35 per cent. to the number of shift men.

An able management, having the co-operation of its employees, can often do very much better. For example:

The Charles Warner Company put its lime kilns on three shifts with no increase in the number of shift men.

The W—— Brick Company obtained more service from its kiln firemen in eight hours than previously in twelve.

The American Rolling Mill Company put its blooming and bar mills on three shifts with an increase in personnel of but 11 per cent., its open-hearth department with an increase of but 15 per cent.

6. What is the effect of eight-hour as compared with twelve-hour shift operation on the quantity and quality of production, absenteeism, labor turnover and industrial accidents?

It is impossible to give average quantitative results for any industry in which a majority of the plants have changed to a three-shift basis of operation but evidence is available to show what is attainable under good management and when the cooperation of labor has been secured.

The report shows that in practically every major continuous-industry there are plants which have increased the

quantity of production per man up to as much as 25 per cent. In a few exceptional cases the increase has been much higher.

For example:

The output of ore per man in the Tennessee Copper Company increased from 30.49 tons per day to 35.42, an increase of 16 per cent., in spite of the reduction in hours.

The efficiency of the men at the Bayonne refining plant of the International Nickel Company increased approximately 20 per cent.

The average number of man-hours to produce one barrel of cement in fifty-one plants operating on two shifts is 1.035. The corresponding average for twenty-two plants operating on three shifts is 0.823 or a decrease in the number of man-hours per barrel of 21 per cent. The corresponding average for thirteen plants working partly on two shifts and partly on three shifts is 0.756 man-hours per barrel or a reduction from the two-shift group record of 27 per cent.

In one department of the Texas Portland Cement Company the increase in the number of barrels of cement ground per day was from 4,000 to 5,500 or 37.5 per cent.

In a Louisville flour mill the output was increased 100,000 barrels per year or 30 per cent.

In the sulphuric-acid plant of the Tennessee Copper Company the pre-war two-shift standard production of 0.372 ton of acid per man per day increased under the three-shift system to 0.878 ton of acid per man per day or an increase of 130 per cent. This took place during a period of eight years and there had been a number of improvements in the plant and process. From May to December, 1921, the cost of acid making was reduced 43 per cent.

It is impossible to give definite quantitative results regarding improvements in quality due to the shorter work period. The evidence shows that an improvement in the quality of production has often followed the reduction in the

length of shifts. In many cases, however, such improvement has not been noted.

On no point has there been more unanimity of evidence than that the change from two to three shifts practically always reduces absenteeism and labor turnover, and in a marked degree.

The evidence as regards accidents is inconclusive. There may be fewer accidents to process and equipment, but no correlation has been found between reduction in hours and reduction in personal injuries.

7. How do wage-rates on eight-hour shift operation compare with wage-rates on twelve-hour shift operation?

In changing to three-shifts hourly wage rates are most commonly increased about 20 or 25 per cent.

If wages are rapidly rising, the increase may be 50 per cent. (making daily earnings for eight hours equal to those previously paid for twelve hours). But only part of this increase should be attributed to the shortening of hours. If wages are going down, or if there is unemployment, the day may be reduced to eight hours and the hourly rates left unchanged. In general, industries which are newly on three shifts pay somewhat higher hourly rates than they would pay if they were on two shifts.

In the long run plants which remain on twelve hours are compelled to pay substantially as high rates per hour, that is 50 per cent. more per day, as their neighbors which are on eight-hour shifts.

8. What is the general opinion of managers of three-shift plants regarding three-shift as compared with two-shift operation?

There is a natural divergence of opinion as to the advan-

tages and disadvantages of three-shift operation, but the weight of the evidence and the most positive statements are in favor of three-shift operation. This is evidenced by the following testimony:

In almost all cases of the steel plants reported upon in 1920 as having changed to three shifts, the managements state that considering the intangible as well as the tangible factors they were better satisfied with the three-shift than with the two-shift operation.

The manager of a three-shift company whose plant ranks among the largest in the industry in 1922 reiterated his feeling of satisfaction with three-shift operation and added: "We are strongly opposed to twelve-hour shifts, though not opposed to a ten-hour day where conditions seem to make that desirable. We believe that industry in this country can be so conducted as to permit of eight-hour shifts in continuous-operation."

The management of the Palmerton, Pennsylvania, plant of the New Jersey Zinc Company is of the opinion that their costs are lower under the eight-hour system.

The superintendent of the Tennessee Copper Company is positive in attributing the increase in efficiency to the two-shift operation.

The management of a beet sugar company is gratified over the results of the three-shift system and feels a satisfaction in the greater contentment of the men under improved working conditions.

A Philadelphia flour mill superintendent declares there is no question but that flour mills can be put on three shifts with real financial profit to the mill.

On the other hand, the superintendent of an Indiana Gas plant could not see much difference in the efficiency of the men on twelve-hour and eight-hour shifts.

A Colorado gas company found that three shifts took

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one-third more shift men than two shifts. It was questionable whether quality had improved.

9. Do employees make good use of the increased hours of leisure?

The evidence is conclusive that leisure time of four extra hours per day is used to good advantage.

It is spent in gardening, truck farming and in doing odd jobs which otherwise would have to be paid for or would not be done at all. Or it is used for recreation, for family or social life, or for following the individual's personal interests. Workmen often require education or experience with the value and use of leisure to make them willing to give up some daily income in exchange for it.

10. To what extent have plants reverted to two-shift operation?

In the course of the field investigation a few plants reported having reverted to two-shift operation after a trial of the three-shift system. Their proportion to the number operating on three shifts is so small as to be negligible. The weight of evidence shows that when a plant changes to three-shift operation it is very unlikely that it will revert to the former system.

Part III
THE IRON AND STEEL INDUSTRY

BY
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CHAPTER XVI

INTRODUCTORY—THE SITUATION OF THE INDUSTRY

A PREREQUISITE IN INDUSTRY—ECONOMICAL OPERATION

THE chief guiding principle for an industry is that it shall be run economically, in order that it may survive under the stress of domestic and foreign competition. The question to be solved in connection with "continuous operations" which are so prevalent in the iron and steel industry is: What is the most commercially-economical number of hours that the average laborer can work in a day, from the viewpoint of:

1. His productivity: In a day;
In a week;
In a year.
2. His skill, carefulness, endurance, alertness, intelligence, judgment, regularity, morale, good will.
3. His attraction to the work, so that it may benefit by the maximum supply of labor of the highest type.
4. His persistence in the work, so that once he has been trained in the operations and his good qualities and faults have been learned, he will remain as an asset in the industry.

From the technical aspect a laborer is not regarded merely as a soulless machine. On the contrary, a wise executive

policy takes into full consideration the importance of the human and intellectual side of labor. There is no economy in saving one thousand dollars by grinding down workmen, and then losing ten times that sum through lack of care, attention, morale, or other preventable causes, dependent upon the mental or psychological attitude of the men, as distinguished from their merely physical condition.

On the other hand, it is obviously of no permanent benefit to the men if their hours on duty are shortened beyond the point where the industry can survive under competitive conditions, or even if the most economical hours are established, under conditions of cooperation and mutual assistance, and the laborers, by withholding their cooperation, defeat the commercial advantages that might have been obtained. An injury to the industry is an injury to the men as well as to the management and stockholders.

"Continuous-Operations."

In this discussion it should be borne in mind that by "continuous-operations" is meant those operations which continue for twenty-four hours a day, and several days—or even years—in succession. The hours of the laborers required for these operations must be a fraction of twenty-four hours, as, twelve or eight. But the nature of the operations is such that they may not require the constant labor of the men, although they do require their being constantly on duty.

Neither are all the laborers employed in the iron and steel industry constantly on duty in connection with the "continuous-operations." Only a portion of the men are necessary for this twenty-four-hour duty.

Therefore, the problem resolves itself into the twelve-hour shift versus the eight-hour shift for this portion of the workmen only, considered in its commercial and economical

aspects, as well as the technical aspect of the question, namely: How will the relative economy or effectiveness of the two systems of dividing the twenty-four hours of labor be affected by different types of apparatus, by different conduct of the operations, by mechanical (or other) devices for replacing a part of the labor, etc. ?

Old Conditions and the Twelve-hour Shift.

The principle of the twelve-hour shift is a survival of the time when it was the custom to work men long hours, and when the mechanical side of the iron and steel industry was less perfectly developed, so that periods of enforced idleness of the mill and the men occurred much more frequently than at present. Even when no break-down of apparatus occurred, the nature of some of the operations was such that peak loads of great intensity alternated with periods when the process requires little or no labor. Some of these peak loads were so taxing that it was imperative that they be followed by rest and recuperation, and some of the valley loads were so light that it would be almost impossible to find useful work for the men to do even if they were not in need of rest. Consequently it was the custom for the men to rest, or to leave the immediate vicinity of their work, or even to sleep, while technically on duty, with the result that the normal twelve-hour shift was not overtaxing. A more important commercial and economical factor of the type of work in some operations, notably the blast furnace and the open-hearth furnace, was that usually a man could not perform a reasonable amount of physical labor during eight hours of being technically on duty, for he would be actually engaged for only four to six hours in a day.

When, in the course of modern progress, the manufacturers of some other commodities reduced the work-day to

THE TWELVE-HOUR SHIFT IN INDUSTRY

... the iron and steel manufacturer ... he did not see how he could do ... the day from twelve hours to eight hours, ... any reasonable expenditure of money on the part of the men. The twelve-hour shift ...

... man an ... about a hundred tons ... of the men would ... the other half working ... the night the men ... hours of sleep ... when the peak loads were to be ... men were needed. These ... human ... a method of overlapping crews, ... the time of these ... operation were ... when the peak ... Therefore, if labor were ... each crew would still ... of engineer men, or nearly so, ... and each man would be idle as ... as when the crews were ...

... a slight modification of this statement, ... physical power, and some greater ... resulting from the men ... not enough to alter the price ... the only man ... of a strong man at the ...

Change in Conditions Today.

But today practically all the heavy labor at the blast furnace is handled by machinery; a very much smaller crew than eighteen men can take care of all the work at a modern furnace making 600 tons of pig iron in twenty-four hours. The manual labor remaining comes in peak loads about five times in twenty-four hours, and periods of idleness between. The chief difference is that the labor cost per ton of pig iron is very much less, and therefore the economic factor of increasing the labor by employing three crews, instead of two, is a smaller item.

It should be said, moreover, that there is one American blast furnace of very modern construction which works its labor in three shifts and permits no periods of idleness.

At the open-hearth furnaces also the heavy peak loads are now handled, whenever desired, by labor-saving devices, although there is still a good deal of irregularity in labor requirements from hour to hour, with resultant opportunity for rest periods, though not for sleep. Finally, the enforced idleness due to mechanical break-downs is now much less frequent.

Influences Deferring the Three Shift System and Questions Involved.

Obviously, the chief cause of the three shift system is operating to perpetuate the two shift system. In iron and steel works have been greatly decreased in intensity and not easily removed. The reason for this is to prevent the industry from being shut down during the winter months. Instead of two shifts, the industry has already become satisfied with the three-shift system. However, hesitate to adopt the result will

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be. Will there be an increase of labor efficiency or productivity to absorb a good part of the extra cost of working three crews instead of two? Will the apparatus be capable of increased production if the men work harder on shorter hours? If the answer to these questions is negative, will there be other compensating economic benefits, such as less need of repairs, less labor turnover, fewer accidents? If the answer to the questions is affirmative, then where is the extra labor coming from? Will diluting the present skilled labor force with raw recruits produce a commercial set-back? Will three shifts increase the difficulty of fixing responsibility? Will the men misuse their added four hours of freedom from duty? Will they be more subject to labor agitators?

DEFINITION: THE TWO-SHIFT SYSTEM VS. THE TWELVE-HOUR DAY

The two-shift system does not mean that every man working in the plant labors for twelve hours every day. Far from it! In fact we find, although all the men may be on two shifts, it is only the so-called "continuous-operations" which require attention for the whole twenty-four hours; the men who are merely accessory to these "continuous-operations" are not on duty all the time. The two shifts for these latter men may be of only ten hours' duration each, in which case there will be a period of two hours at the end of each shift when their places will be vacant.

Working Hours in 1920.

A report of the United States Department of Labor, released for publication May 24, 1922, gives the following percentages of workmen in different departments of iron and steel works, for the year 1920 classified as to the number of hours worked per day:

TABLE 13
IRON AND STEEL WORKERS IN 1920

	Working 12 hours per day	Working 8 hours per day	Others (by difference)
At blast furnaces.....	63%	18%	19%
Bessemer mills.....	75	22	3
Open-hearth mills.....	50	30	20
Puddling mills.....	20	20	60
Blooming mills.....	60	25	15
Rail mills.....	60	40	
Bar mills.....	Over 50%	15	Under 35%
Sheet and tin plate mills.....	Under 10%	60-70%	Over 25%

These figures of the year 1920 are probably the best ones to use for normal recent indications, because although many plants adopted the eight-hour day for several classes of workmen during the slack period of 1921, they did so at a reduced daily wage merely for the purpose of keeping a larger number of men employed. The object was to keep the men busy at shorter hours and lower daily wage, rather than to keep a less number of men on the same wages. Some of these plants returned to the two-shift system as soon as the commercial situation warranted their producing a larger output. Some plants were forced to return because competitors were working their men twelve hours at twelve hours' pay and the men who were only getting eight hours' pay were attracted away by the higher daily wage, notwithstanding the longer hours that went with it.

Shortening of Hours from 1910 to 1920.

If, now, the figures for the preceding decade are examined, it will be seen that in recent years there has been a great decrease in the proportion of employees of the iron and

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steel industry working long hours, and a large increase in those who had an eight-hour day. This statement is supported by comparison of the figures in the Department of Labor report just mentioned with those in Documents Nos. 110 and 301 of the 62nd Congress, 2nd Session, entitled "Conditions of Employment in the Iron and Steel Industry in the United States."

The data in these several publications are not all arranged exactly the same way, so that some estimates have to be made in order to make the figures comparative by classes, but the error is less than 1 or 2 per cent. either way. Comparisons seem to be possible only in the case of the blast furnaces, Bessemer mills, and open-hearth mills, because the data referring to rolling mills are classified differently in the several publications, but the relations of hours worked in these three fundamental manufacturing departments are sufficient to throw light on the subject discussed in this study.

THE EIGHTY-FOUR-HOUR WEEK

According to these government figures, the following table shows the percentages of employees of the three fundamental manufacturing department working eighty-four hours per week in 1910 and in 1920.

TABLE 14
IRON AND STEEL WORKERS EMPLOYED 84 HOURS PER WEEK
IN 1910 AND 1920

	Working 84 hours per week	
	In 1910	In 1920
At blast furnaces.....	75%	29%
Bessemer mills.....	18	12
Open-hearth mills.....	24	17

As nearly as can be estimated from the data given, the following table gives the percentage of laborers in the same three departments who worked the long and the short shift respectively, in 1910 and in 1920:

TABLE 15
IRON AND STEEL WORKERS ON TWO SHIFTS AND ON THREE SHIFTS
IN 1910 AND 1920

	Working 12 hours		Working 8 hours	
	1910	1920	1910	1920
At blast furnaces.....	69%	63%	1%	18%
Bessemer mills.....	65	75	16	22
Open-hearth mills.....	76	50	2	30

The proportion of men working twelve hours in the Bessemer mills is an exception to the general trend, but the Bessemer process has been on the wane for many years, and the number of men employed is probably very much reduced since 1910.

Almost all the men who work either nine or ten hours per day are those who are accessory to the "continuous-operations"; that is, it is not essential that their places be occupied during all the twenty-four hours of the day. A comparison of this class of employees for 1910 and 1920 is shown in the following table:

TABLE 16

	Percentage of employees working either 9 hours or 10 hours per day	
	In 1910	In 1920
At blast furnaces.....	30%	19%
Bessemer mills.....	19	3
Open-hearth mills.....	22	20

Two-shift Plan vs. Twelve-Hours Actual Work.

The fact that men on the two-shift system do not actually work for twelve hours, but rest a good deal of the time while on duty, is exemplified by blast-furnace operation, in which it is common practice for the men to have one or two periods of two to two-and-a-half hours each during a shift for rest or sleep. In some plants rest houses are provided at the blast furnaces, (less occasionally at the rolling mills), where popular and semi-technical magazines are kept on file, and where the men are permitted to loaf or sleep when not required for active duty, but always on call in case of need. Some plants have cafeterias and soda fountains, where the men are permitted to go for refreshment between periods of active labor. They are paid for these intervals provided they are within the plant and on call.

Many managers sincerely believe that the two-shift system of this type, namely: twelve hours' duty, twelve hours' pay, with seven-and-a-half to eight hours only of active work and rest intervals between, is better for the health of the men than eight hours of continuous labor. This view, however, does not take into account the insufficiency of the rest which the men on the night shift obtain, due to only eleven hours between shifts. These men have an opportunity to sleep only in daytime, and often during hot weather they return to their work at 6 P. M. more tired than when they left it.

Another two-shift system which also differs from a twelve-hour work day has been in vogue during the depression in the iron and steel industry in 1921 and 1922. It consists of working two shifts of eight hours, nine hours, and sometimes ten hours each and allowing the equipment to lie idle during the intervals between. This has been adopted merely for the purpose of decreasing output. In every case investigated, however, with one exception, it has been only partially

successful in decreasing output—that is to say, the output per hour has increased so much that two ten-hour shifts at certain rolling mills have produced more tonnage than was formerly produced on twelve-hour shifts. In another case, two eight-hour shifts produced within a negligible fraction as much as had been produced in two twelve-hour shifts. It was necessary in one case, where reduced tonnage was imperative, to limit the output of each shift. When the men had rolled the limit, they went home, regardless of number of hours worked. The working time was usually less than ten hours, notwithstanding that all took things easy.

The result in these plants cannot be ascribed wholly to increased efficiency of the men working shorter hours. In one case it was due to the removal of a previously unsuspected “bottle neck” at the furnaces which heated the material for rolling. When these furnaces had an interval both before and after each shift, they coordinated so much better with the roll trains that greatly increased output per hour was possible. Until additional furnaces could be installed, it would be impossible to estimate how much of the hourly increase in productivity was due to equipment and how much to labor.

Two Shifts with Idle Periods—Difficulties.

The two-shift system with idle periods of equipment is not possible at blast furnaces or open-hearth departments. And, wherever it is adopted, it involves waste of fuel in that idle furnaces must be maintained hot. It may be thought that the idle mill and machinery will increase overhead expenses, but this is obviously not so when the output must be limited in any event.

In some cases the statement has been made that the plan just mentioned resulted in saving on account of affording a better opportunity to keep the equipment in repair. In

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one case this was denied, on the ground that there is always apt to be a break-down soon after idle machinery or equipment is started again, regardless of how carefully it is inspected and repaired between operations, and that therefore the idle periods actually caused increased interruptions by break-downs.

Summary.

The differences between the two-shift system and a twelve-hour work day may be summarized as follows:

1. Even where the two-shift system is the rule of the plant, only two-thirds to three-fourths of the employees work twelve hours;
2. Even those who are on duty for twelve hours, and are paid for twelve hours, are actually engaged in labor no more than from seven to ten hours; an average of nine hours would not be far wrong, counting times of emergency, etc. But these men are subject to labor, if needed, and subject to orders for the whole twelve hours, which they must spend in the plant;
3. Two shifts may be worked, leaving idle periods at the end of each. Thus the men will work less than twelve hours each.

DEFINITION: THREE-SHIFT SYSTEM VS. THE EIGHT-HOUR DAY

As great as the difference between the two-shift system and the twelve-hour day is that between the three-shift system and the eight-hour day. Taking the Table on page 16 as an illustration: If all the twelve-hour men in that Table were changed into eight-hour men, we should have a three-shift system throughout the iron and steel industry. But, when

the change is made, it is found after study and some experimenting that some of the men working two shifts of twelve hours each can be changed to two shifts of ten hours each, thus giving the men easier hours with the same daily wage and no expense to the industry. Others can be changed to three shifts of eight hours each, and, simultaneously, forced to take on a little more work, thus decreasing the size of the crews. This is discussed in detail on page 228.

The ideal achievement from the technical standpoint would be to work all the eight-hour men continuously, without any loafing periods, and always on operating productivity. While this has been found possible at rolling mills (see page 256, with actual saving of cost over the two-shift system, it has not, so far, been found possible at blast-furnaces or open-hearth mills. The Ford Motor Company, however, requires that its men work at something during the entire eight-hour shift. Between productive operations these men are engaged in cleaning up, painting, adjusting, inspecting, etc., the different parts of the blast furnace and its accessory apparatus. The management attributes to this constant attention and watchfulness the circumstance that all parts are clean and open to inspection, and that the need of repairs is observed before either the repairs, or the consequences of neglecting them, become serious. The management believes that a great deal of expense is saved in this way. The principle may be stated as follows: The crew, although not engaged constantly in operating productivity, is engaged constantly either in productivity or in avoiding waste.

Questions Involved in Proposal for Shorter Shifts.

The American iron and steel industry is at a disadvantage in answering some of the technical questions involved in the proposal for shorter shifts, because it never has had a well-developed research department upon which exec-

utives could predicate changes in practice. Thus, most of the important technical advances of great magnitude, even though invented in America, have had to be tested and exploited in foreign countries before they were generally adopted in the American industry—for example, gas engines at blast furnaces; electric production, or refining, of iron and steel. With England and Europe in an abnormal commercial condition after the War, and with labor triumphant after forcing on the industry the adoption of the three-shift system without opportunity to prepare in advance by research or technical advances, the American industry cannot look abroad for an answer to these questions. (See pages 245 and 246.

Furthermore, it is not to be inferred from America's experience with shorter shifts in 1921 that a larger output is necessarily obtained from the twelve-hour shift. The year 1921 was a time of depression in the iron and steel industry; manufacturers did not work either their men or their equipment to full capacity. Nevertheless, it was noted at many plants, and reported to the investigator during his visits, that there was a marked increase of efficiency of labor during the period of working eight-hour shifts. Some attributed this increased efficiency to the better rest which men were able to obtain between shifts, and others to be the increased eagerness of men to hold their jobs, which intensified their activity as long as they saw a gang of men seeking employment. It was noted that the efficiency of labor decreased with the decrease in surplus of labor available. Therefore, the conclusion which many superintendents of departments have drawn from the experience of 1921, namely: that the eight-hour shift very greatly increased the efficiency of labor, must be qualified to the extent indicated. Unfortunately we do not know whether the increase of efficiency observed was due wholly to the eight-hour shift, or wholly to the psychological

effect of knowing that men were available seeking one's job, or partly to both causes. Attention is called elsewhere (see page 288) to the possibility of securing the increase of efficiency from both causes at once, even during a time of labor shortage.

There are other points of doubt which militate, at present, against the adoption of the eight-hour shift for "continuous operations." One question asked by executives is this: If men are given twelve hours' pay for eight hours' work, will they not still be discontented and agitate for twelve hours' work at the advanced rate? As noted elsewhere, however, (see page 288) there seems to be no good reason to expect such a result, if the proper remedy is applied.

The Real Issue.

A second question asked by executives, however, is more important: Do the men want the eight-hour shift? Now if this question really means—as I understand it—Do the men want the eight-hour shift with eight hours' pay at the present hourly rate? then I believe there can be no question that they do not! The present daily wage of three dollars and sixty cents, which is given for twelve hours' work at thirty cents per hour, is as low as any on which even "common labor" can live in America and support a family.

This last question seems to bring the whole matter to a definite issue. Evidently, if the eight-hour shift is to be adopted, "common labor" must be paid the same daily wage as at present, and some technical or commercial compensation found in the conduct of the operations. If that is not possible, and if profits at present cannot stand the extra production cost, then the twelve-hour shift must be continued until a change occurs.

CHAPTER XVII

CHANGING TO THREE SHIFTS—GENERAL CONSIDERATIONS

CONDITIONS PRECEDENT TO CHANGE

ASSUMING for the sake of argument that the management and stockholders of an iron and steel company have decided to abolish the twelve-hour shift as soon as practicable; to do so as economically as possible, but to pay the cost of the change out of profits, if necessary; what conditions are important from the technical viewpoint, and what provisions should be made?

1. The equipment must be in satisfactory condition, so that it will respond to increased intensity of operation, if any, and increased efficiency of labor, if any.
2. The cooperation of the men must be secured.
3. Additional labor, both skilled and unskilled, must be available.
4. The technical staff must be prepared to furnish full information regarding all available labor-saving appliances.
5. Existing "bottle necks" must be eliminated, and probably "bottle necks" which will appear after production is speeded up must be foreseen as well as possible, and provisions made to eliminate them.
6. "Peak loads" must be studied with especial reference to lightening them with mechanical appliances.

7. Progress must be gradual; too many changes cannot satisfactorily be made at once.

Importance of Adequate Equipment.

The capital expenditure necessary to put the equipment in satisfactory condition will not be wasted even if the hopes of the management are disappointed and there is evidenced no increased efficiency of labor to intensify operations. This will be the more true if we keep in mind the seventh condition and proceed gradually.

Cooperation.

True cooperation can result only from confidence. If the men mistrust the motives of the management in changing from two shifts to three shifts, they can easily destroy many of the compensatory benefits which might accrue to the enterprise in return for the risk or financial sacrifice made. On the other hand, if there is entirely frank discussion, in advance, of the change; if the past record of the management is such as to inspire the men with confidence in their sincerity; if the men learn that they may themselves speak freely without exposing themselves to being discriminated against, then it has been proved that the men can give suggestions of real value, and their loyalty, attendance, promptness to work, good will, response under emergency, care, attention, and general morale are better. All this not only facilitates the change, but it helps all over the rough places, reduces labor turnover, and makes the daily work more attractive to all.

The larger the company the more difficult it is to inspire in the laborers confidence in the motives of the management. This is a psychological handicap which is inherent in an organization of great size. It may, therefore, be easier for

the smaller companies to make the change than for those of larger magnitude; it may even be better for the industry for the smaller companies to change first. It is the fact that those companies which have already adopted the three-shift system are all comparatively small. The great organizations can perhaps most easily convince their men of their sincerity if they frankly adopt the principle of abandoning the twelve-hour shift in imitation of smaller competitors, provided they do not delay so long that the men demand it before the management offers it. The disastrous effects of changing merely in response to a demand from the men is shown in the results of the change in the European countries, as discussed on pages 245 and 246.

The Question of Additional Labor.

Even the fondest advocates of the three-shift system admit that some additional labor is necessitated by the change from the twelve-hour day. If the change is made gradually, however, and if the cooperation of the men is secured, the additional skilled labor may be trained in the plant itself. No case exists, so far as known to the investigator, in which labor was not available at the prevailing daily wage, and even, in some cases, at a slightly reduced daily wage, to supply the need when the eight-hour shift was adopted. Those plants which have adopted the three-shift system have found that labor was attracted from other occupations because of the short day, or from other localities.

The statement just made may appear to be contradicted by the experience of many companies in 1922, which adopted the three-shift system in 1920 and 1921, when the reduced activity of the steel industry caused a surplus of labor. The companies in question worked several departments on three eight-hour shifts, paying the same hourly rate, and therefore, of course, a daily rate of 33 $\frac{1}{3}$ per cent.

lower than before. This cost them nothing and kept a greater number of men busy. The men were willing to work on these terms (since they could get no better) so long as their jobs were in jeopardy, but as soon as the steel industry became more active and they could get work elsewhere, they left the eight-hour plants and applied for work at twelve-hour plants. In other words, they wanted more money even if they had to work twelve hours to get it. Some of the best began to be attracted away, because they were the men who found it easiest to secure the work at twelve-hour plants. This experience was somewhat widespread geographically, and perhaps did more than any other one thing to prejudice executives against the three-shift system.

But this experience has been cited many times by those who have remained on the three-shift system as an instance of going about the change in the wrong way and of drawing wrong conclusions by erroneous interpretation of events.

Dubious Inferences.

Failure to consider all the facts seems to have led in some cases to incorrect inferences. For example, the prevailing wages for common labor in the northern steel districts is thirty cents per hour; in rare cases less is paid, and in the southern districts, much less is paid. It is admitted that even the commonest laboring man cannot support a family decently on \$2.40 per day. It may have been more humane to pay three men \$7.20 a day, and work them all eight hours apiece than to pay \$3.60 to two men for twelve hours' work each and let the third man depend on charity. But whatever may have been the rights of this action, and it would seem to have been best and wisest under the circumstances, it was an expedient to meet a situation; it was not an application of the three-shift principle; it was rather a form of social economy during an industrial crisis whose application

ceased when the crisis passed. It did not even afford an opportunity to judge of the efficiency of labor, because neither labor nor equipment were employed on the basis of efficiency, but purposely on the basis of reduced productivity. In many cases no attempt was made to economize on labor where economy was easily possible, because the object of the change was to keep as many laborers employed as could be kept without increase of expense.

Nevertheless, it has been reported to the investigator that many laborers were dispensed with because a smaller crew in eight hours could do the same work as a larger crew in twelve hours. In one or two cases the crews were reduced at the suggestion of the men themselves. All this was under circumstances very adverse to increased efficiency and without introducing any additional labor-saving mechanical devices. It was an illustration of what might be called involuntary and uninspired increase of efficiency due to the shorter day. It was not a fair criterion of what improvements in labor productivity might have been achieved if the management had planned carefully in advance and carried through the change with executive skill and a desire to effect an improvement which would give permanent relief to the men. The maximum hours worked by approximately one-fifth of the workers in the iron and steel industry—twelve hours per day, eighty-four hours per week, and 4,383 hours per year—are to be compared with 2,500 hours per year, the maximum which any man is permitted to work in the Ford Motor Company, including the iron blast-furnace department.

Some authorities will contradict at once the statement that the increase of efficiency in the cases referred to was "involuntary and uninspired." They will declare that the increased eagerness to work was inspired by the men's knowledge that their jobs were in jeopardy; that a large gang of unemployed was waiting outside the gate to take the place

of any man whose work was unsatisfactory; that the increased efficiency of labor was in direct ratio to the size of this gang seeking employment; that it was this inspiring object lesson rather than shorter hours of work or longer hours of rest which was the real motive force within the laborers that impelled them to greater efforts. If this be true, then it only remains for the technical staff to perpetuate the inward impelling motive to work at the peak of the laborer's ability, and at the same time, to take advantage of the greater ability to work which comes with shorter hours and longer rest.

Failure Through Lack of Cooperation.

Mention should be made here of the experience of a plant which did change to the three-shift system after planning by the management and with the hope of effecting a permanent improvement in the long hours worked by its men. When the labor-demand of the industry in the same district began to increase, the laborers at the plant in question began to desert them for plants where they could get twelve hours' work with twelve hours' pay. Some of their best men were leaving, and in self-defense the management changed back to the twelve-hour shift in several departments. The news of this experience naturally spread very fast among executives, and spread the fear of the three-shift system.

The management of the plant in question received the investigator very courteously and gave him all the information about the situation which could have been asked. No possible criticism could have been made of them for any unwillingness to answer questions which concerned their lack of success with their plans for the three-shift system—questions which so vitally touched their competitive position in the industry. So far as could be learned, however, their lack of success was due chiefly to the fact that they were unable to secure the cooperation of their men. Perhaps this

failure was due to the temper of the men rather than any fault of the management; there are reasons for believing that this may have been so. The wholly impersonal and technical conclusion is, however, that this lack of cooperation was alone sufficient to defeat the meritorious attempt on the part of the management.

Other contributing causes were that the management did not give enough study to the question of equipment, to the lightening of peak loads by mechanical appliances and did not make the change with sufficient deliberation and gradualness. Neither had they correctly anticipated the necessity of capital expenditure which would have successfully solved some of the apparently insoluble problems which were encountered. It may be that these conclusions are mistaken, but if this is the case, it is because the management was not free to give the information which would have corrected the misapprehensions.

The name and identity of this plant must, for obvious reasons, be concealed; it has not been mentioned to anyone in connection with the conclusions formed, nor is the description here given sufficient to identify it among others.

The Question of Labor—Summary.

Summarizing the condition of available labor for the three-shift system:

1. The plants which have adopted the three-shift system and are paying wages a little lower than are paid at corresponding plants working twelve-hour shifts have sufficient labor, both skilled and unskilled.
2. The management of these plants, in the majority of cases, believe that they attract a better class of labor because of the shorter hours.
3. The executives believe that the superior labor and

the full supply of labor comes to them because of, not in spite of, the eight-hour day.

4. Every executive interviewed who has had sufficient actual experience with both systems to speak with authority declares in emphatic terms that the labor turnover is much less on the three-shift system than it is on the two-shift system.
5. Sufficient skilled labor can be trained in the plant if the change is made with the cooperation of the men, and if it is made gradually.
6. It is not necessary to pay a full twelve-hour wage to skilled labor in order to get a sufficient number to work the eight-hour shift.

Other Points.

Other items might be listed but require only brief mention at this point. Labor-saving appliances are discussed under the head of the different departments, such as: blast-furnace, open-hearth, etc. The subject of "bottle necks" is obvious and requires no special discussion, besides being usually individual to each plant. "Peak loads" are considered in Chapter XIX. The wisdom of deliberation in making the change to the three-shift system is noted in several places in this study.

RESULTS TO BE SECURED, TO MAKE COMMERCIAL SUCCESS

If it be assumed that labor must be paid a little higher rate per hour, or per ton, in order to bring about the change to shorter hours without too much discontent, then one or more of the following improvements must be realized if the change is to be a commercial success:

1. There must be an increased output per man per hour in order to partly offset the increased labor rate.

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2. There must be a gradual improvement in the type or intelligence of labor attracted to the industry. This improvement will not be observed of course, except after a period of years.
3. The quality of the product as a whole must improve, or else, the proportion of first quality product as compared with second and third quality product must increase.
4. There must be less waste of materials in process. This means, for example, pig iron scrap at the blast furnace; sloppings, spillings, and short ingots, in the steel mills; cobbles, off-size product, unnecessary croppings, clippings, in the rolling mills.
5. There must be decreased use of materials for linings, or other parts of the apparatus or equipment.
6. There must be a decrease in the number or the seriousness of repairs.
7. There must be fewer interruptions of the processes because of delays due to errors of judgment; to lack of perfect coordination between the different departments or mills; to lack of attention, care, etc.
8. There must be fewer accidents to men. A little reflection will convince one that this is a technical as well as a humanitarian consideration. Accidents decrease the attractiveness of the type of labor, thus influencing the supply of labor; they cause delays, lack of attention, decrease in morale, and temporary demoralization.
9. There must be better conduct of the operations—for example, less “pigging up” in the open-hearth.
10. There must be greater regularity or uniformity of the processes.

11. There must be less absence from work, and less tardiness.
12. There must be decrease in labor turnover, which will save at the employment office and also in the operating department through lessening the inconvenience and waste of working new men at intervals.

Probability of These Results.

While there are operators who will deny the probability of every one of these compensating economies, the actual condition is that, wherever the three-shift system has been put into operation in accordance with good technical practice, as outlined, some of these desiderata have been realized, thus offsetting, at least in part, the extra cost due to the increased labor rate. Unfortunately it is not possible to give figures to show how near to 100 per cent. this compensation is. In many cases plants are not in possession of exact figures. In other cases the change was made during a period of labor surplus, when the efficiency of labor was increased, as already noted on page 238, by psychological influences, quite independent of the three-shift system. Finally, the management in some cases takes the stand, properly enough, that figures of this nature are quite confidential. Many estimates have been given informally by those having experience, and they vary all the way from a compensation greater than the increased cost to one of only one-third of the increased cost.

A Reasonable Minimum.

It would not be quite fair, of course, to use even this last figure as the basis of definite estimates, but I, personally, believe that it represents the minimum that may be expected under good normal conditions for the change. This opinion is based upon observations and many opinions given to me

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during some weeks of study and observation at plants of the following types:

1. Two-shift plants which never tried three shifts.
2. Two-shift plants which tried three shifts and changed back.
3. Three-shift plants whose management is well satisfied with the results achieved.

The opinion is offered for what it is worth, with a statement of the basis on which it is founded.

Instances of Lasting Success with Three Shifts.

That there are plants which have been in operation for several years with evident success is a fact which strongly supports the favorable opinion just expressed. The opponents of the three-shift system maintain, however, that some special circumstance operates in each such case, which prevents our accepting this favorable conclusion as applicable to the industry in general. Now there are special circumstances operating in every iron and steel district of the United States which give that district an advantage over its competitors: for instance, the Birmingham District has a favorable labor rate and low assembly cost, and the Pittsburgh District has a low fuel cost. These advantages are, in some cases, greater than the total labor cost per ton of pig iron, for example.

Furthermore, we have blast furnaces operating on the three-shift system and producing pig iron in competitive centers at lower than the market cost; we have open-hearth furnaces operating on the three-shift system producing steel castings in direct competition and paying dividends; we have Bessemer mills at large plants which have for years been employing some types of skilled labor on the three-shift basis with satisfaction to the management and stockholders;

we have rolling mills which employ the three-shift system at an actual saving in labor cost (see page 24). Therefore, we may assume that it is possible to employ the three-shift system with some degree of technical and economical success.

Failure if Conditions Are Wrong.

It is manifest, however, that the three-shift system may be employed with a conspicuous lack of both technical and economical success.

In the first place, success is least likely if the change is made at a time when most pressure is put upon management to shorten the hours of labor. Good results cannot be expected if the change is made

1. Merely on the demand of the men, or under pressure of the Government;
2. During a time of labor unrest;
3. When labor is arrogant, or elated by a victory.

In the second place, good results cannot be expected if the transition is made too abruptly, that is, if too many changes are made simultaneously.

Unfortunate Results in Europe.

The disastrous results of the shortening of the hours of labor in thirteen European countries shortly after the close of the World War, contrasted with the contrary experience in those American plants where the change was made under the right conditions, furnish all the evidence we need to prove the truth of these statements. In every European instance three of the undesirable conditions mentioned above existed—sometimes four of them—and, in addition, the labor situation had been made still worse by the killing off of many of the younger and more active men in the War. The

results of the change in European countries were published by The International Labour Office, Geneva, Switzerland (American Correspondent, Ernest Greenwood, 618 Seventeenth Street, N. W., Washington, D. C.), in a "Preliminary Memorandum," issued May 5, 1922, and commented upon in *The Iron Age* of May 18, 1922. Even the most superficial study of the data furnished demonstrates that the European labor situation was so bad that industry could not have been carried on successfully under any circumstances, much less when a drastic change was brought about as the result of strife between labor and capital. Everywhere labor conditions were unsettled; political and industrial relations in many cases approached bolshevism; strikes, riots, violence, preceded the victory of labor which forced the change to the three-shift system, and left labor in an arrogant attitude which destroyed discipline. In some cases the laborers extorted the eight-hour shift from the management of the steel works, and then, instead of using the extra hours for rest and recreation, took additional employment in other works to increase their income; naturally there was no increase of efficiency, because the men were doing double duty. The management was at the mercy of the men and the ordinary rules of discipline could not be enforced.

There was an increase of wages from the pre-war level because of the deterioration in the value of the money, but no account was taken of this circumstance in the report made by some of the countries as to the change; while it seemed to indicate an increase of cost due to the three-shift system, it was in reality quite independent of the change of system. The efficiency of labor had been reduced by years of ill-nourishment in war times and underfeeding during the period when the results were observed. Moreover, the increased efficiency of the men on shorter hours, if any, would not have been effective in most cases, because the market was so bad

that the plants could not sell their output if they increased it and because, according to reports in many cases, the quality of raw materials was inferior, and the fuel was inferior, or insufficient in amount, or both.

Finally, the management was at the mercy of the men, and the ordinary rules of discipline could not be enforced. In several instances plants complained that the labor situation was so disturbed and unsatisfactory that men arrived at the works late and left before the shift was over; the men took less interest, deliberately decreased their energy and activity, wasted tools and materials, and absented themselves from work without notice. In some cases the reports from the several countries say in so many words that no deductions can be drawn from the result because of the demoralization of labor. The report from Spain, for example, shows an increase in cost of 50 per cent. to 400 per cent., due, as stated there, not to the three-shift system, but to tremendous wage increases brought about by strife and riots.

Some Bright Spots in Europe.

Nevertheless, it is to be noted that in the midst of this black picture many instances were met of increased labor efficiency. The fact is very encouraging.

Thus the Minister of Labor of Belgium reports that the increase of labor force consequent on the change to the three-shift system, instead of being 50 per cent., as might be expected was as follows:

At blast furnaces, 46 per cent.

Open-hearth mills, 22 per cent.

Basic Bessemer, 24 per cent.

Rolling mills, 29 per cent.

In Finland there was an increase of production of about 30 per cent., and the labor increase, instead of being 50 per cent. was between 5 per cent. and 30 per cent., and there was

a saving of fuel of about 15 per cent. This notwithstanding the facts that the men were more subject to agitation during their extra hours of leisure; that they were more tardy, and allowed outside interests to interfere with their work. In England the open-hearth production increased between 14 per cent. and 18 per cent. notwithstanding that inferior raw materials and disturbances on account of demobilization interfered with output. In Italy the increase in the number of workers was only between 20 per cent. and 50 per cent., and the increase of labor cost between 35 and 50 per cent. In Jugo-Slavia one rolling mill increased its production by 15 per cent. and a wire mill produced 20 per cent. more, consequent on the change to three shifts. In Roumania about 30 per cent. more men are now required. In Spain the number of men required has increased by from 25 to 50 per cent., and where good discipline prevails, output per man has increased by 7 to 10 per cent.

CHAPTER XVIII

LABOR COSTS AND TOTAL COSTS

LABOR COST PER TON—LIMITATIONS AND POSSIBILITIES

It is obvious that wages must be increased by 50 per cent. per hour if men are to make as much per day when they work eight hours as when they work twelve hours. If men are paid according to tonnage, then the rate of pay per ton must increase 50 per cent. provided they are unable to make a greater tonnage per hour. Now, let us assume temporarily that they cannot make more tonnage per hour than they are already making. This may not be a function of the men's efficiency, but may be due either to the fact that the maximum capacity of the equipment has been reached or to the fact that the limit of possible sales has been attained.

Three Methods of Meeting Three-shift Requirements.

Under these circumstances, one of three courses may be pursued:

1. The management may employ 50 per cent. more men and pay their wages out of profits.
2. The number of men employed may be increased 50 per cent. and the wages of all reduced $33\frac{1}{3}$ per cent., thus leaving profits the same.
3. The number of men employed may be increased 50 per cent., and wages per day (or per ton, as the case may be) reduced by $16\frac{2}{3}$ per cent. Thus labor

and profits each lose money, share and share alike. This has been called the "fifty-fifty" basis.

All three of these methods have been tried with success, in particular instances, and are still in operation, although, of course, wage adjustments have occurred in some cases since the change was made, apparently modifying the method, as to whether it is the first, second, or third of those mentioned.

Larger Costs—How Far Offset by Savings and Profits.

Enough cases are on record in which the three-shift plan has been tried here in the United States and has been continued with satisfaction to the management and stockholders to show that profits can be made with labor working three shifts. In these cases, manifestly, profits must have been sufficient to pay the additional labor costs which have been necessary. This may be due to either of two causes:

1. Profits must have been great enough to absorb the 50 per cent. increase in labor costs and still satisfy management and stockholders.
2. The increase in labor cost must have been less than 50 per cent., or must have been compensated by savings in overhead, repairs, amortization, waste, losses due to inferior product or similar causes.

To precisely what extent profits are decreased and cost of production increased by changing labor from two shifts to three shifts cannot be made public without violating that secrecy which prevails in all competitive industries. But Robert A. Bull, in a paper before the American Foundrymen's Association, published the results of a change from two shifts to three shifts on the open-hearth furnaces of the

Commonwealth Steel Company "which," he says, "indicates fully a more economical and efficient manipulation of both open-hearth and boiler furnaces." Major Bull is an acknowledged expert and authority on open-hearth steel manufacture; twice President of the American Foundrymen's Association. He has been instrumental in changing other open-hearth plants from two to three shifts, even in the center of America's competitive steel industry, the Pittsburgh District. He is still of the opinion that the savings in cost of operation, quality of product and uniformity of operation and output, fully compensate for the expense of working the "continuous-operation" laborers on three shifts instead of two shifts. This opinion is based on the "fifty-fifty" basis; that is, labor and profits each sharing in the cost of employing the extra number of men necessary. It is also predicated on the change being made in the right way and under the right conditions, as already explained in Chapter XVII.

In this opinion of the possible savings equalling the extra cost, Major Bull is supported by at least two other steel experts, and one blast-furnace operator. It is right to state, however, that other executives express the belief that the cost of three shifts is slightly greater than the cost of two shifts, especially if the total extra labor cost is to come out of profits. (In this connection, as to blast furnaces, see pages 275-6.)

LABOR COSTS IN RELATION TO TOTAL COSTS OF IRON AND STEEL PRODUCTS

It is a common observation that 90 per cent. of the total cost of iron or steel is of labor. Some one might then argue that increasing the labor costs by 25 per cent. would increase the total costs 22.5 per cent. In actual results, however, the figures do not work out that way, unless we increase the labor

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cost right through from ore in the ground. Let us illustrate this by an example of cost of making pig iron:

COST OF MAKING PIG IRON	
	Per ton
Raw materials.....	\$9.31
Flux.....	.56
Fuel.....	4.68
Operating labor.....	1.27
Overhead and other expenses.....	.79
	<hr/>
Total cost.....	\$16.61

On this basis the labor cost appears as only 7.7 per cent. of the total cost.

It may be urged, of course, that overhead and materials are also composed chiefly of labor, which makes the total cost consist chiefly of labor. However, from the standpoint of cost involved in adopting the three-shift system, we may disregard the labor cost of raw materials and flux, as well as overhead, because they are not manufactured by "continuous-operations." No changes would occur in these cost items if all the "continuous-operations" were changed from the two-shift to the three-shift basis. It is true that the operation of making coke from coal is a "continuous-operation," but the labor cost of this also is but a fraction of the cost of the fuel.

Labor Cost Only a Small Proportion of Total Cost.

The cost of making pig iron quoted above is the cost of making 119,081 tons of pig iron in the year 1907, and is taken from "Tariff Hearings Before the Committee on Ways and Means of the House of Representatives, Schedule O, Part 1," page 1421. These cost figures are, of course, now long out of date; costs have increased since that time, but there has been no material change in the relation of operating

labor costs to total costs; whatever change there has been has operated to decrease the relative proportion of labor costs.

In other words, considering the blast-furnace operation in and by itself, the labor cost is not more than 8 per cent. of the total manufacturing cost; if, therefore, we change the blast furnace labor to the three-shift system and thereby increase the operating labor cost per ton of pig iron by 40 per cent. we would only increase the total manufacturing cost by 3.2 per cent. It is true that the wages of blast-furnace labor were increased almost 40 per cent. in some cases when the three-shift system was adopted in the United States in 1921 by companies which adopted it merely for the purpose of keeping more men employed and made no special effort to effect compensating economies in operation, but so large an increase as 40 per cent. is not necessary when the change is made in the right way, as already pointed out in Chapter XVII. In any event, it is evident that the cost of pig iron will not be greatly increased by changing the blast furnaces to the three-shift system.

On page 1766 of the "Tariff Hearings" just referred to we have the average cost of making Bessemer pig iron in the United States from 1902 to 1906. The tonnage represented is 51,900,000 tons. The proportion of labor cost to total cost is 5.5 per cent., which indicates a still lower figure as the cost of changing to the three-shift system.

When we come to the Bessemer process itself, the case is somewhat different, but here again the matter is not very serious in cost per ton. The raw material is pig iron, and its cost will be higher because of the labor increase in that department due to the change to the three-shift system. Then we must assume that the operating labor in the Bessemer department will increase, say, 25 per cent. Thus we may have a total increase in cost per ton of 5 to 5.5 per cent. maximum.

In the open-hearth department we are worse off for the fact that operating labor is about 7 per cent. of the total cost per ton, but this is offset very largely by the fact that the raw material consists on the average of at least 50 per cent. of steel scrap, whose price is determined by market conditions, and is not affected by the three-shift system. Even if we do not effect economies in practice which offset a good part of the extra wage-rate due to the three-shift system, the increased cost per ton will be only a little over a dollar per ton. The fact is, moreover, that a good deal of the open-hearth steel made yearly in the United States is made by labor already working on the three-shift system.

In the rolling mill operations which concern us—blooming mills, slab mills, billet mills, wire rod mills, plate mills, etc.—the operating men on “continuous-operations” represent but a small fraction of the total cost. They are the lever men, who operate the levers that actuate the rolls, the roll tables, the shears, etc., the heating furnace men, etc. It is true that there is also a large gang of crane men, maintenance men—that is, the millwrights, electricians, etc., who keep the equipment in order and the laborers who are called upon when needed to remedy trouble—but the maintenance men and laborers usually work but a small part of the time, and it has been found possible in many plants to work them on two ten-hour shifts. The number of crane men and lever men has been a good deal reduced in the process of changing from the twelve-hour work day to the three-shift system.

Obviously, these different figures will vary somewhat for different localities and even for different plants in the same general locality. But this is true of all costs. For example, Judge Gary testified, in June, 1922, that the United States Steel Corporation, which has plants in all the districts of the country east of the Mississippi River, could produce about three dollars per ton cheaper than the independent companies.

This represents about 5 per cent. of the manufacturing cost of most large products. The economy of operation is not a function of the locality of the plant.

If, therefore, we could secure technical and commercial advantages through the adoption of the three-shift system no greater than the advantages which the Steel Corporation has over its competitors, the economies resulting therefrom would at least absorb the cost of the added labor, without drawing on profits. This is offered to show that we are not expecting unreasonable things of the system to ask it to make that technical advance, through increasing the efficiency of labor and through better conduct of the operation.

INSTANCES OF LABOR COSTS LOWER WITH THREE-SHIFT PLAN

Reference has been made to the opinion of experts who believe that the greater efficiency of labor, and other saving circumstances, such as repairs, overhead, waste, quality, labor turnover, etc., make the three-shift system an economic and commercial advance. But these opinions cannot be supported by figures because cost figures are necessarily surrounded by the utmost secrecy. And the opinion of those who think there is a slight balance in favor of the three-shift system is opposed by the contrary opinion held by others who also have had experience with both systems. However, there are some instances of actual labor savings which have been communicated to me personally with permission to include them here, on the understanding that no company names are mentioned.

The Rod Roller.

One of the most conspicuous of these is at a Garrett wire rod mill in a competitive center, which changed from two to three labor shifts several years ago, and is still operating its "continuous-operation" labor on eight-hour shifts.

The work of a rod roller at Garret mills is hazardous, hot and severe. The roller stands in the midst of three or four coils of white-hot, rapidly moving bands of steel. The point of metal shoots from between the rolls at the rate of about a mile a minute at maximum speed, because it must be rolled so fast that the heat produced by the mechanical kneading of the metal shall more than counteract the radiation from the 1-inch section of rod. It is actually hotter at the end of the rolling than it was when it came from the furnace. The roller catches it deftly in his tongs, swings the end around in a circle, so that the swiftly-moving rod forms a long coil on his side of the roll train, and then passes it back between the rolls, to be caught by his "buddy" on the opposite side. This operation must be performed in time to turn back and catch the next rod as it comes through. Always there are several writhing coils on both sides of the train of rolls. The least mistake or lack of attention is almost certain to result in an accident which may cause loss of metal being rolled or of human life.

Obviously this work requires the maximum of expertness and attention, and it is universal to have a double set of rollers on each twelve-hour shift, relieving each other at intervals. But at the mill now in question the double crews on twelve-hour shifts were changed several years ago to single crews on eight-hour shifts, with a saving of 25 per cent. of the labor. This saving has been continued ever since, with apparent success.

It is not the function of this discussion to comment on the humanitarian aspect of the change, but if it be urged that such a saving, which involves working men under severe strain for eight hours continuously, is a hardship, then the answer may be made that from the technical standpoint, we may change all the double crews on twelve-hour shifts to single crews on eight-hour shifts and allow each of them

relief for 25 per cent. of the time—that is, for two hours out of every eight-hour shift—without using any more labor than is employed at present. Each man would work, say, one hour and then be relieved for twenty-four minutes. It is evident that if it has been done satisfactorily for so many years without any relief for eight hours, then it can be done with corresponding increase of efficiency if five rest periods of twenty-four minutes each are interposed.

Crane Men.

Another example of saving is a case of work on cranes which was very severe because the men were exposed to strong heat. They declined to work, even with some intervals of relief during the twelve-hour shift, unless “oil-ers” were employed to take care of the motors and mechanism on the bridge. But when the eight-hour shift was introduced, they voluntarily tended both levers and bridge mechanism with consequent saving of 25 per cent. of the number of men employed.

In another case, the men themselves, in a spirit of good will resultant upon the introduction of the eight-hour shift, pointed out a slight change whereby three men per turn could be reduced to two men per shift. It is true that in time the management might have noticed this possible saving itself, but it had not done so for years, and men who are closely engaged in a manual operation can often see improvements which an onlooker may overlook.

Pitmen and Bottom Men.

Two other instances are: pitmen in an open-hearth mill, where two men working the twelve-hour shift were replaced by single men on the eight-hour shift, and bottom men on soaking pit furnaces, where one man on the shorter shift re-

placed two men on the twelve-hour shift. The open-hearth pitmen work around the hot slag and keep the pit clean; their work is severe both physically and from the heat-endurance standpoint. A somewhat spectacular account of this work was given in the *Atlantic Monthly* for May, 1922, as an introduction to an article on the policies and practices of the U. S. Steel Corporation. The soaking pit furnaces heat steel ingots while they are standing on end preparatory to rolling them to blooms; slag, scale, etc., collect in the bottom of these furnaces, and the work of cleaning them out is severe. In this case, as in the example of the open-hearth "cinder snappers," or pitmen, it is a matter of opinion whether two-man crews on the twelve-hour shift is not over-manning, and one-man crews on the eight-hour shift is not under-manning, but the examples are here cited as instances of actual experience.

Other Cases.

There are other cases of a more general nature. For instance, the management of a plant which changed from two to three shifts, and has been working the shorter shift for a period of years, declares that less labor is used both on the open-hearth platform and in the pit. It is true that at least a part of this saving is due to the use of labor-saving appliances which might have been installed without introducing the three-shift system, but there are a very great many plants which lack some or all of these labor-saving appliances and which could introduce them with profit. The interest and maintenance charges against these appliances, plus their cost for power, constitute only a small fraction of the labor cost per ton of metal in open-hearth practice.

A second plant advises me of its experience in full confirmation of the result stated in the preceding paragraph. Furthermore, this experience proves that the saving is due at

least in part to the increased ability and efficiency of the men working the shorter shift, quite independent of the labor-saving appliances. And if any plant management in the country claims to be as fully equipped with labor-saving appliances in its open-hearth department as possible, it can be asserted confidently that this is not so, although, doubtless, many plants believe themselves to be fully equipped, or at least, to be as fully equipped as the plant management thinks economical.

Still another plant reports that its rolling mill crews increased their efficiency by more than 50 per cent., after changing from two to three shifts, and that in the tin house, the number of men on accessory operations was reduced when the change was made from twelve-hour to ten-hour shifts. It may be argued that the improvement was possible because this particular plant was below the standard of efficiency, or of discipline, before the change, but there appears no justification for such a charge. And the management of the plant in question asserts as the lesson of its experience on two shifts and on three shifts, that wherever the work is very taxing, either from the physical or the heat-exposure conditions, men can do as much work in eight hours as they can do in twelve. This assertion is, of course, quoted here as bearing upon the evidence under discussion, not as an accepted generalization. Other executives—as has been stated previously—with experience with both systems of labor employment, declare that men do not produce so much in eight hours as in twelve hours.

This part of the discussion may be appropriately concluded with the statement of a technical truth which we believe is universally accepted, namely: that what can be technically accomplished in one or two instances can be repeated as a matter of regular practice, provided the conditions are understood and repeated. Therefore, if these examples of

labor economy can be made at any plant, they can be made at all plants where the same conditions are repeated.

**INSTANCES OF LABOR COSTS HIGHER BUT TOTAL COSTS
LOWER**

There are at least two instances in which the skill, care, uniformity, expertness and attention of the workmen have so important an effect on the cost of the operation that it has proved economical, in some cases, to work them eight hours instead of twelve hours. It cannot be asserted that it is universally cheaper to pay 50 per cent. higher labor costs per ton of product for these skilled operations, but only that it has proved cheaper in certain cases where careful records have been kept. The two operators in question are: the scale car man at blast furnaces, and the blower of the Bessemer converter. Each of these men receives a wage which is from a fraction of a cent per ton of product to about two cents per ton of product. A slight increase in expertness or attention on the part of either may save several times the wages paid them. If the converter blower comes to work insufficiently rested or suffering from a bilious attack the temperature of the metal and the percentage of second quality product may vary so far from the standard as to run into hundreds of dollars in a day.

There is a difference of opinion as to whether the shorter shift will make an important difference in the expertness of the blower, but careful records and observation in one case, and general experience in more than one other case, have convinced the management that the cost of the shorter shift is far exceeded by its savings. This conclusion may be attacked on technical grounds, and therefore a little space given to it may be necessary.

The Converter Blower.

The converter blower is the man who judges by eye the temperature and the chemical conduct of the Bessemer process. His cooperation is encouraged by paying him a wage based on the product of the Bessemer mill. His observation of the flame issuing from the mouth of the converter determines the practice as to increasing or decreasing the temperature of the metal in the converter and the time at which the operation is stopped. His skill in operating the levers has its effect on determining the percentage of waste of metal. His control over the time when a vessel is put into service every twenty minutes or so determines the regularity with which the supply of metal coming into the mill may be maintained, so as to give the least interference and the greatest rate of flow. The Bessemer mill is run on the principle of a cycle of short operations, repeated a great many times, and each adjusted to the other so as to minimize the interferences and delays. On the regularity with which the ingots—or train loads of ingot cars—flow from this mill, depends the economy of operation of the rolling mill which usually it serves.

It has been said of some skilled operations in steel mills that they are performed better at the end of a twelve-hour shift than at the beginning. I have never heard this said of the converter blowing and my own observation and experience of several years would oppose such an assertion. It might be said that if the blower misused his extra four hours of leisure, he would do his work worse on three shifts than on two, but this is a case for discipline. It happens that the supply of converter blowers is ample for at least the next decade and that they may be trained without special difficulty. Discipline may be applied better on the three-shift system than on the two-shift system because men are more attracted to these jobs when the hours are shorter.

The Scale Car Man.

The scale car man at the blast furnaces operates an electric larry, which travels under a series of storage bins at the back of the furnace. The larry receives its load from one of these bins, weighs it, controls the weight in accordance with the "burden" established by the proper official, carries it to the foot of the furnace and dumps it into the charging skip, which in turn conveys it to the mouth of the furnace. Operation of the larry is arduous because it requires care, close attention, and is of a monotonous character.

So far as has been learned, no scale car men are able to work steadily for twelve hours, and no one has ever said that their attention or regularity was better at the end of a twelve hour shift. The regularity with which the furnace is charged is the chief factor in determining the temperature of the top gases, and affects the fuel economy of the operation. In the best practice, the amount of coke used per ton of pig iron made will be from 1,800 to 2,000 lbs. ; this will cost, say seven dollars per ton of pig. (Of course, this rate will vary enormously, depending on the location.) If the fuel economy falls off as little as 1 per cent., the cost per ton of pig would be increased seven cents, representing thirty-five dollars to forty-five dollars loss in twenty-four hours. It is easy to see how increased loyalty and efficiency on the part of the scale car man can run into profits on production.

Therefore, the efficiency of the scale car man is kept up by relieving him at intervals during twelve-hour shifts. This is done in at least three different ways. He may be allowed resting periods, with the result that the stock-line level falls, the top-gas temperature rises in consequence and a certain loss of fuel economy is endured. Or, secondly, an extra man may be employed for a group of several blast furnaces who relieves the scale car men in succession, besides doing other work, such as keeping stock records. Or, finally, the skip

operator may relieve the scale car man at intervals, which usually involves some irregularity in the operation of the charging skip. At the most modern furnaces, however, records are kept automatically of the stock-line level, the top-gas temperature and the regularity of operation of the charging skip, and discipline is applied when any irregularity in these records is shown and cannot be properly explained. But it is the observation of many blast-furnace superintendents that regularity cannot be maintained on the twelve-hour basis. Where the scale car man works only eight hours, the statement has been made that he is able to do his work regularly and continuously for his whole shift.

Possible Economies in Rolling Mills.

Such slight experience as has been collected from those who have employed rolling mill labor on the twelve-hour shift and the eight-hour shift, indicates a decided increase of efficiency of the lever men, when working on the shorter shift, manifested in increased output, fewer repairs, and less "cobble" (pieces in process which have met with accident and must be scrapped). There is also some compensating economy in the elimination of "spell hands," who take the place of the lever men at intervals, in order to give them rest and relief; this relief is necessary on the twelve-hour shift but can be dispensed with in part, or altogether, on the eight-hour shift.

INSTANCES OF LABOR COSTS AND TOTAL COSTS BOTH HIGHER

Except in those cases where we can show a saving because of increased labor efficiency and a saving on account of improved quality, regularity of operation, etc., it is evident that all operations of the iron and steel industry will be more

costly per ton of output when working three shifts than when working two shifts. There are many cases in which, as will be obvious to everyone acquainted with the subject, it is not possible to lower the cost per ton by working three shifts instead of two shifts. For example, the engineers in boiler houses and power plants have very little to do except watch and tend the machinery or fires. In the case of the boiler houses, better attention might be given by men working the shorter shift, and better attention may give lower costs, but certainly in the engine room, so far as the investigator has learned, the operation is so regular and break-downs are so infrequent that increase of efficiency on the part of the men could have little result in lowering costs. The subject has been considered at some length in connection with this study, but it does not seem probable that a difference of opinion will be met, at least as far as steel works power plants are concerned, and therefore a discussion does not seem warranted. The amount of money involved is not very large, because a few engineers are spread very thin over a great tonnage produced in a large plant, and if a change were made to three shifts, it would doubtless be based on humanitarian, political or psychological grounds.

In the case of those men who keep the equipment in good condition, and who are known variously as maintenance men, millwrights, electricians, it is now common practice—though not universal—for them to work on two shifts of ten hours each, with twelve-hour shifts only in cases of emergency. Where they have been employed on eight-hour shifts they have often abused the privilege by working four or more hours at outside shops, such as automobile repair shops, electric repair work, etc. Under good disciplinary conditions it is possible to prevent this, because it is recognized as unjust both to the plant that employs them and to their fellow-workmen, but where the three-shift system results from a victory of labor

over the management, or where labor is arrogant or demoralized this and other abuses are rampant. This is clearly shown in the "Preliminary Memorandum Prepared by the International Labour Office, May 5, 1922." (See page 246.)

Obviously, in the cases just mentioned, the labor costs per ton when working on three shifts of eight hours each, will be 50 per cent. higher than those when working on two shifts of twelve hours each. Some assert that the costs are even more than 50 per cent. higher, because labor is even less efficient on eight-hour shifts than it is on twelve-hour shifts. This assertion may be true in the experience of those who make it, but it is not true when the change is made wisely and the conditions are understood.

OTHER PROCESSES AND DEPARTMENTS

There are many other departments of the iron and steel industry to which only incidental reference has been made in this book because they are either already operating very largely on the eight-hour shift in general principle, or else because the number of men involved is small in comparison with the number in the blast furnaces, the open-hearth mills and the rolling mills. Thus, some of the labor in the Bessemer mills is operated on the eight-hour shift, some on two shifts of ten hours each. Puddling mills and crucible steel departments are decreasing in number, and the principle of the eight-hour shift is largely prevalent in them. Some of the finishing departments operate on two shifts of ten hours each and some operate only during daylight hours. In any event, the finishing departments would probably follow the practice of the prime producers.

CHAPTER XIX

THE PEAK AND VALLEY LOADS

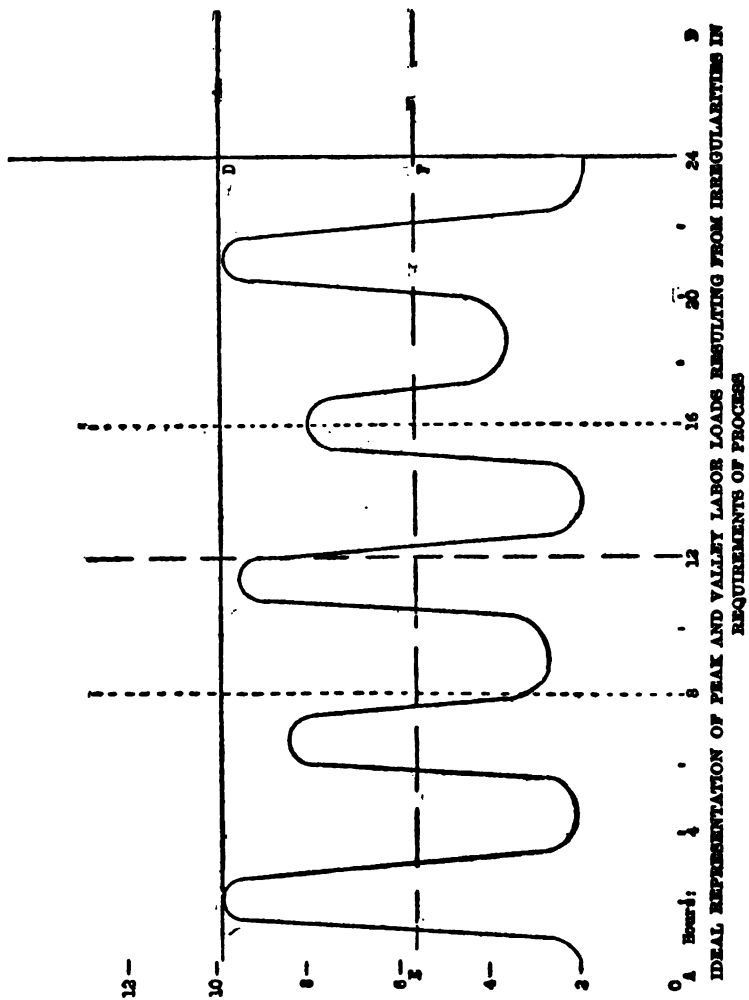
PEAK LOADS—CONDITIONS

REGARDING the elimination of peak labor loads, it is well to note that the severity of the labor involved in a manual operation may be due either to great physical exertion demanded, such as carrying heavy loads of pig iron a distance of a hundred feet or so, repeated many times in the course of two hours; or to exposure to very high temperature, such as repairing the tap-hole of an open-hearth furnace; or to both together, such as cleaning up a mess of semi-liquid slag, or shovelling broken metal into a ladle containing one hundred tons or more of white-hot steel.

If we could know just when peak loads would occur, it would greatly simplify the problem of carrying them, but the peak loads which result from break-downs are obviously going to occur at times impossible to predict, and the inevitable irregularities of furnace operation bring peak loads sometimes at one hour of the day and sometimes at another. This irregularity prevents the handling of the peaks by an extra gang, working only when needed. And so we must always have on hand a crew of men sufficient to handle the maximum load that the process is going to require, with the certain result that some or all of these men are going to lack occupation when the labor requirements of the operations are small.

Labor Requirements.

This will be made more clear, perhaps, by reference to Fig. 1, which is an idealized representation of peak and valley loads at a furnace during a twenty-four-hour interval.



The labor requirements of the process are indicated by the ordinates, and the hours of the day by the abscissae; the twelve-hour shift is indicated by the broken line, and the eight-hour shifts by the dotted lines. The curved line represents the labor requirements at the different hours. For simplicity it is made more regular than will usually be the fact. From this curved line it is evident that the maximum labor requirement is ten men; and therefore, ten men must always be on duty; with the two-shift system this means twenty men to cover the twenty-four hours; with the three-shift system it would be thirty men. But, now, if we could eliminate the peaks in the labor loads; smooth them out and distribute them evenly over the twenty-four hours, the line *E-F* would represent the average labor requirement of the process, and six men would handle it. That is, 12 men would be required per day on the twelve-hour shift or eighteen men per day on the eight-hour shift, fewer than are required to take care of the peak loads working the twelve-hour shift.

This, then, is what is meant by the peak loads involving the necessity of having men on hand who lack occupation during certain phases of the furnace operation. It is obvious that, under the conditions just mentioned, the ten men, working eight hours, cannot exert a reasonable amount of energy during their day's labor.

Partial Relief Through Labor-saving Devices.

It is also evident that if we could handle the greater part of all the peak loads by labor-saving devices, as few as four men could take care of all the rest of the labor requirements and would work pretty steadily during their shift. This achievement would solve the three-shift problem by making the practice economical, by giving each man steady work for

eight hours and allowing him sixteen hours per day for rest and recreation. It would also make the labor requirements so constant that a man working twelve hours would be unfairly taxed, and the usual double shift, that is, the twenty-four-hour shift which comes every two weeks when changing shift, would be a real hardship.

It is not here claimed that the technical advances in the iron and steel industry have accomplished so much as is indicated above in eliminating almost all the peak load by means of labor-saving devices, but they have done a great deal. For example, comparing an old-fashioned blast furnace, without labor-saving devices with a modern furnace equipped as it should be: the former will make, say two hundred and forty tons of pig iron per day with about forty men per shift, or eighty men per twenty-four hours, an average of three tons of pig iron per man per day. The modern furnace will make six hundred tons of pig iron with one-half the number of men to do the same work¹; an average of fifteen tons of pig iron per operating man per day. This advance is due to mechanical and other labor-saving devices as noted below, page 272.

It is true that even with this advance the peak loads are not yet eliminated from the blast-furnace operation, but they are greatly reduced, so that one of the most modern of American blast furnaces keeps its men steadily occupied on what the management believes is economical work for the whole of three eight-hour shifts per day. (See page 231.) Furthermore, the management of this furnace believes that what peak loads do occur can be handled with slightly fewer men working the eight-hour shift than working the twelve-hour shift, on account of increased efficiency and morale.

¹This does not include power house, etc.

Variation in Peak Loads According to Department.

The peak and valley loads, shown in Fig. 1, are not exaggerated for the normal practice of the blast furnace. For the open-hearth furnace the irregularities will still be great, but not so great (under good modern practice of labor-saving appliances) as at the blast furnace, except when accidents, delays or interruptions occur. In the case of the Bessemer mill and the rolling mills, the normal irregularities are still less, but especially in the case of the rolling mills, idle periods due to break-downs, with consequent peak loads for the "maintenance men," are not uncommon. Now-a-days they occur much less frequently than a decade or two ago, on account of mechanical improvements and use of electrical power. They are a great source of added expense in manufacturing cost per ton of output, not so much on account of the cost of repairs, but because of delays and interruptions, which decrease output and correspondingly increase overhead and labor expense per ton. Any added efficiency of the men as regards greater care or alertness in preventing accidents or delays, more expert operation of the levers to increase output, avoiding mistakes or false moves, will make itself evident immediately in improved practice which lowers costs.

Advantages With Three-shift System.

Consider now the question of peak loads occurring normally in furnace operations, as illustrated in Fig. 1. A peak load will be noted as coming at the eleventh hour of the first twelve-hour shift; this shift is already fatigued by handling two peak loads; the temptation will be, if not actually to delay operations so as to defer this peak load until the next crew comes on duty, at least to avoid hastening matters so as to get the full work to do. This is not a theory; it is a common

experience! Even a loyal foreman cannot have the same regard for the dividends of an absent, and almost mythical, stockholder as for the fatigue of men, who in hot weather and under conditions of furnace irregularity are sometimes in a pitiable state of exhaustion.

Those who have not seen the three-shift system in successful operation may argue that whereas this delaying of the peak load so as to "let George do it" can come only twice during the twenty-four hours on the two-shift system, it will come three times on the three-shift system, and that the result will be worse delay than before. Much time has been given to studying this question at plants working on the three-shift system, with former experience on the two-shift system, and the testimony received has been universally in favor of the three-shift system, for four reasons:

1. The men are not fatigued by eight hours' work; the temptation to shirk is not so great.
2. Discipline is better; you cannot put much pressure on a man when he is so tired that he is almost ready to quit.
3. A long rest is coming.
4. There is not the same bitter feeling towards the work which the long shift sometimes engenders.

PEAK LOADS AT BLAST FURNACES—ECONOMIES AND AIDS

When a modern blast furnace is tapped and one hundred and twenty-five tons of liquid metal run out into the cast house, the labor of taking care of this product is immense, as well as the labor of making the cast house ready for the cast. Even the labor of opening the tap-hole used to be great on some occasions, but this is now minimized by the use of oxygen to burn a hole through. The labor of closing the hole is

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now much less, on account of the use of the "mud gun" to do this work.

Improvements in Recent Years.

The first reduction of labor in the cast house came through the use of jib cranes wherever a place could be found to support them; then of travelling cranes spanning the cast house; then of pig breakers" to eliminate the sledge hammer to break the pigs away from the sow. Finally, the cast house was dispensed with entirely and the liquid pig iron was allowed to run directly into ladles supported on railroad cars, and taken away from the blast furnace to be stored in reservoirs until wanted at the steel works, or else cast into pigs in mechanical pig-casting machines. The last word in labor economy is to get the runners so short, by good design of the furnace house, that we shall have the minimum length of "skull," because some iron chills in these runners, forms a "skull" and has to be broken up and disposed of.

The cast house crew used to consist of:

One keeper.

One first helper.

Four to eight assistant helpers, who used to prepare the "pig beds" to receive the liquid iron; open and close the tap-hole; run the cast; look after the runners, etc.

Four to eight iron carriers.

One "cinder snapper."

One "scrap man."

One man to look after the hot blast stoves.

This crew can now be reduced to:

One keeper.

Two helpers.

One "cinder snapper."

One hot blast man.

When working eight hours instead of twelve, the crew is reduced to four men, one of the helpers being eliminated, and it is even said that it might be reduced to three, if the runners could be made so short that the "mud man" and the scrap man could both be dispensed with.

Back of the furnace we used to have piles of ore, flux, and coke from which piles shovellers filled hand buggies which were wheeled to the foot of the furnace, weighed, carried up in an elevator, and dumped into the top. It took more than twenty men to do this work.

Now-a-days back of the furnaces is a long line of bins, which are filled directly from the railroad cars which bring them to the plant, or else by great gantry cranes which span the storage piles and the storage bins. Underneath these bins runs an electric larry, as described elsewhere, which eliminates much manual labor. Instead of the twenty-three men who used to handle eight hundred tons of material charged into the furnace, six or eight men now handle more than 2,000 tons of "burden" or "stock."

Advantages With Three Shifts.

This "stock pile" work, or filling, is not subject to peak labor loads, as is the work in front of the furnace, which increases every time the furnace taps, say five times in twenty-four hours. Consequently the fillers do not normally get any resting periods in their twelve-hour shifts. Theoretically there are enough men to overman the job, and the filling crew can rest at intervals, provided the furnace is kept always full. In practice it usually works out that the management makes a concession to the fillers by which they are allowed a half-hour's rest occasionally, with the result already noticed, however, of some reduction in furnace efficiency.

Contrast this with the practice of the Ford Motor Company's blast furnace at River Rouge, which is run on an eight-hour shift and a forty-eight-hour week. An automatic record is kept of the height of the stock line in the furnace, the temperature of the top gases, and the times at which the charging skip makes its trips; any deviation from regularity in these particulars is checked up and explained. The high wages and short hours prevailing there make it possible to enforce the most rigid discipline where necessary, and no concessions of furnace efficiency are made to provide resting periods for the men. Indeed, resting is not permitted; the men must keep occupied during the full hours of labor. This applies to the labor in front of the furnace, as well as to the fillers and stock men.

We cannot prove that a lower efficiency of stockline level is universal in connection with the twelve-hour shift, nor yet that a substantial improvement in this efficiency would pay the labor bill for an extra crew to work the eight-hour shift, but it has been a result of observation that the stock-line level is maintained more nearly uniform in the plants on the eight-hour shift than in those on the twelve-hour shift. This is one of the ways in which the eight-hour shift can help pay for itself, and reduction of the crew in front of the furnace, and better work of this crew, is another way. Of the crew of men filling the furnace only about five out of the six or eight are today working on a twelve-hour shift; the others, such as the men who keep the ore pockets (i. e. the ore bins) full, often work two shifts of ten hours each.

It will be noted that if sufficient labor were added to put all the blast-furnace men, now on twelve hours, on an eight-hour basis, the increased cost would only be about thirty cents to forty cents per ton of pig iron, even if no compensating economies were secured therewith. (See page 253.)

Additional Economies Possible.

What are some of the possible economies if the change were made?

1. The possible reduction in some of the crews has just been mentioned.
2. So has the increase in fuel efficiency due to more uniform charging of the furnace.
3. The elimination of the "floating gang" would reduce the labor bill. (See below, page 278.)
4. Other economies are: Fewer absences; less tardiness; reduced labor turnover.
5. It is emphatically asserted by blast-furnace managers using the eight-hour shift that the higher grade of labor attracted by shorter hours, greater care and alertness, better morale, and more skillful supervision and operation are all reflected in a saving in cost of production, greater regularity of operation and quality of product, less interruptions, fewer accidents or breakdowns, and less need of costly repairs to machinery.

Unfortunately, cost figures are highly confidential and cannot be quoted or published. Therefore, these opinions cannot be supported by either statistics or figures. In more than one case furnace operators have assured the investigator that in their opinion, the cost of producing pig iron is less on the eight-hour than it is on the twelve-hour shift.

In this connection it is permissible to quote the management of the Ford Motor Company and say that although the blast furnace operates on the basis of eight hours per day and forty-eight hours per week per man, and labor is paid seventy-five cents and upwards per hour, as compared with

twenty-seven and thirty cents per hour and upwards at other plants visited, nevertheless they make pig iron cheaper than they can buy it. They attribute this to greater efficiency of labor and of operation.

PEAK LOADS AT OPEN-HEARTH FURNACES—ECONOMIES AND AIDS

In old-fashioned types of open-hearth furnaces where the charge is inserted by hand labor there is every reason to believe that the number of men employed in three crews working eight hours each would be no greater for the same amount of work than the number employed in two crews working twelve hours each. But the number of these old-fashioned types of open-hearth plants is small, and the relative importance warrants only a brief mention of the circumstance.

Adaptability of Three-shift system to Modern Plants.

At modern plants the peak labor load comes at tapping time, which occurs from two to four times in the twenty-four hours. Between these times there are almost always many resting periods. The "pouring gang" has its work only when the furnaces tap, and the steadiness of occupation of this gang depends on how often the furnaces tap and how many furnaces there are in the plant. This matter should obviously be arranged so as to keep this gang at work most of the time; then it would not be a serious item of expense to increase their tonnage rate slightly and work them in three shifts, instead of in two shifts with resting periods. The same principle applies to the work of the gang preparing ladles for the "heats," which are the product of the "tap," i.e., the metal from the furnace. The total cost of the pouring gang and the gang that prepares

the ladles for the heats is only a few cents per ton of steel, in a large modern plant, and the expertness and care with which they do their work has an important influence on the waste of finished product.

The gang which repairs and relines the ladles may be employed on two shifts of ten hours each. The "pit gang," that is the gang which keeps the place cleaned up, which removes slag from the pit, disposes of material thrown down, or spilled, has a severe job. The work is hard, and there is danger and often exposure to heat. It has been found possible to decrease the size of the crews on this work when their daily hours are changed from twelve to eight.

It is the crew on the charging platform of the furnace which actually makes the steel. The labor of this crew is today greatly decreased by the "charging machine," which not only takes care of putting the steel-making materials in the furnace, but also charges the flux and ore during the course of the operation, and any pig iron needed for adjusting purposes. Electric appliances have also greatly decreased the work of this crew—for example, the electric appliance for raising the doors of the furnace has eliminated the "pull-up" boy who used to operate the hydraulic or manual appliance. There are also mechanical appliances for changing valves, etc. The labor of the tapping operation used to be severe, but now oxygen is used to open a "hard" hole; with proper care this leaves the hole in good condition, so that the former work of repairing this hole after the tap, while exposed to extreme heat, is now unnecessary; if some work around the hole is needed, it can be done by compressed air. The shovelling of recarburizer into the ladle, while exposed to the extreme heat radiating from the liquid metal, has been replaced by a mechanical appliance, into which the recarburizer is dumped from a wheel-barrow, and which then

dumps it into the stream of metal as slowly or as fast as the operator desires. The worker in charge operates the appliance from a distance, where he can see all that goes on without being near the heat. The labor of repairing lining after tapping, which was always taxing, and which must be done rapidly in order to facilitate the regularity of the mill and reduce delays, may now be done by means of a mud-gun, which shoots a stream of repair material into the furnace at exactly the point desired.

These labor-saving devices have eliminated all the operations requiring severe physical endurance, or exposure to heat. They enable the furnace crew to do its work with less of a tax, and with greater speed. They have revolutionized the work on the furnace platform during the past decade.

The Floating Gang vs. the Sunday Holiday.

Formerly it was the custom to shut down open-hearth furnaces every week-end, but now they are often run continuously for all the four to seven months of their campaign, with important saving in expense. This introduces the expense of the "floating gang," unless the eight-hour shift is in vogue. The "floating gang" is an auxiliary crew of laborers which takes the place of individual laborers in succession for one day each week. This is an arrangement by which the workers on a two-shift system are given a six-day week. It is a great and kindly relief from the old seven-day week system, when a man worked eighty-four hours per week for fifty-two weeks of the year, but it is open to strong objection on the part of the men. They want the free day on Sunday; on other days of the week they cannot enjoy the freedom so much; only a fraction of the time does the "floating gang" system give each man a Sunday off. While this is primarily a sociological question it has its technical aspect,

because it results in men leaving the work for other industries, large labor turnover, irregularity of work, etc.

Departments Operated on Sunday.

Blast furnaces and open-hearth furnaces are operated most economically if run without cessation until their linings² are worn out and they must be shut down for extensive repairs. This means a continuous campaign of some months in the case of open hearth, and of some years in the case of blast furnace. In the Bessemer mill, the rolling mill, the several finishing departments, the tinning mill, the galvanizing department, the wire-drawing department, and some others, it is the custom, on the contrary, to discontinue the manufacturing operation from Saturday afternoon to about Sunday night. During this interval the repair gang may be very actively engaged, but the operating men, at least, have their Sunday free. For these men, therefore, the question of a seven-day week, "floating gang," etc., does not enter.

Accordingly, in discussing the subject we shall confine ourselves to the blast furnaces and the open-hearth mill. These are the two great producing departments in the sense that one of them produces practically all the pig iron, and the other the greater part of the steel made in the country. The total number of men employed in these two departments is but a small proportion of the total number of iron and steel laborers.

Cost of the Floating Gang vs. Sunday Holiday.

It should be noted that the "floating gang" system adds one-seventh, 14.8 per cent. to the labor cost of the seven-day week system.

² True, other parts of the open-hearth sometimes wear out ahead of the linings, but the roof is included as a part of the lining, and the principle we are discussing here applies regardless of which part happens to fail first.

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The three-shift system gives every man an opportunity to enjoy his church and his family on Sunday, without involving the expense of the "floating gang," or the waste due to shutting down the open-hearth furnace at the week-end.

One method of arranging the hours so as to accomplish this is shown in the following table:

TABLE 17
WEEK-END CHANGE OF SHIFTS ON THREE-SHIFT SYSTEM

	First week			Second week			Third week			First week		
	12 n.	8 a.m.	4 p.m.	12 n.	8 a.m.	4 p.m.	12 n.	8 a.m.	4 p.m.	12 n.	8 a.m.	4 p.m.
	to 8 a.m.	to 4 p.m.	to 12 n.	to 8 a.m.	to 4 p.m.	to 12 n.	to 8 a.m.	to 4 p.m.	to 12 n.	to 8 a.m.	to 4 p.m.	to 12 n.
Mon.....	1	2	3									
Tues.....	1	2	3									
Wed.....	1	2	3									
Thurs.....	1	2	3									
Fri.....	1	2	3									
Sat.....	1	2	2									
Sun.....	3	3	1									
Mon.....				2	3	1						
Tues.....				2	3	1						
Wed.....				2	3	1						
Thurs.....				2	3	1						
Fri.....				2	3	1						
Sat.....				2	3	3						
Sun.....				1	1	2						
Mon.....							3	1	2			
Tues.....							3	1	2			
Wed.....							3	1	2			
Thurs.....							3	1	2			
Fri.....							3	1	2			
Sat.....							3	1	1			
Sun.....							2	2	3			
Mon.....										1	2	3
Tues.....										1	3	3

This table may be described as follows:

Crew No. 1 works from midnight to 8 A. M. the first week;
From 4 P. M. to midnight the second week;
From 8 A. M. to 4 P. M. the third week.

Crew No. 2 and Crew No. 3 work the other hours, as shown.

When the week-end change of shift occurs:

Crew No. 1 gets from 8 A. M. on Saturday until 4 P. M. on Sunday free,—thirty-two hours. Each crew enjoys this freedom every third week.

Crew No. 2 gets from midnight on Saturday until midnight on Sunday.

Crew No. 3 gets from 4 P. M. on Sunday until 4 P. M. on Monday.

The week-end system described above gives one crew longer daylight hours of work on Sunday than either of the other crews, but each crew takes this shift in succession, so it comes only once every three weeks for each man. It can be varied, if desired, so that Crew No. 3 comes to work at 10 P. M. on Saturday and quits at noon on Sunday. Crew No. 1 relieves it at that time. Other variations are possible, according to the arrangement which best suits the men themselves.

By this system each man works fifty-six hours per week.

Twice in every three weeks each man works one continuous shift of sixteen hours. This is severe, but not nearly so much so as working twelve hours a day for six days, and is a great improvement on the twenty-four-hour week-end shift which it replaces. An occasional sixteen-hour shift has

not proved in practice to be exhausting when the men work only fifty-six total hours a week, and when it is either preceded by thirty-two hours of rest or else followed by twenty-four hours of rest. The twenty-four-hour shift, on the other hand, is followed by only twelve hours of rest, and it comes every second week instead of every third week.

Importance of Care, Expertness, and Loyalty of Workers.

The work of the open-hearth furnace is very dependent for its economical conduct on the care, expertness and loyalty of the men. There is no process in the industry wherein the men can more easily save, or waste, the company's money. If the crew approaches the end of its shift, it can easily defer the labor of tapping so that the next crew will have it to do, with consequent delay and loss of money; if a bad "puddle hole" is observed in the bottom, it may be ignored, or only partially repaired, and a break-out may occur. Care will increase the life of the furnace, economise on lining materials, save fuel, improve quality, avoid "pigging up," for example. It is true that all these expert furnace men are paid on the tonnage basis, so that they have the incentive to exercise their best care and skill, but it is human nature to shirk a little when one is tired out by long hours of work.

CHAPTER XX

SUMMARY OF THE EVIDENCE

THE GENERAL SITUATION

THE twelve-hour day is strongly established in the iron and steel industry by long custom, and by its unusual adaptability to the requirements of this industry.¹ However, recent progress in the industry has been in the direction of a shorter work-day, as well as a reduction in the proportion of those men who are on duty for seven days a week.²

Peak Loads and the Twelve-hour Day.

For some decades past the labor requirement of the iron and steel industry has included some peak loads of great intensity, from the standpoint of physical endurance, or of heat exposure, or both. Between these peak loads will come periods of rest, or of very light labor.³ This type of labor requirement has been due in part to the special liability of iron and steel furnaces, rolling mills, or accessory apparatus, to break-downs, which necessitate intense activity of the "maintenance men" until they are repaired, with consequent idleness of the other men. Another cause of peak and valley loads is the nature of the operations themselves: For example, during and immediately after the "tapping" of blast furnaces or open-hearth furnaces, all hands are subjected to severe labor. The same is true of the charging of the old-fashioned type of open-hearth furnace. This makes it

¹ See page 221.

² See page 226.

³ See Chapter XIX.

almost imperative to rest thereafter, in the case of all three examples.⁴

Recent improvements in equipment, and the adoption of electrical appliances, have greatly decreased the frequency and the duration of interruptions of the different processes due to break-downs, especially in the rolling mills. Moreover, labor-saving devices, mechanical and others, have lessened the severity of peak loads due to the processes themselves, in respect both to physical endurance and to heat exposure.⁵

Peak Loads and Intermittent Laboring.

Notwithstanding the improvements mentioned above, break-downs still occur at times, and the labor requirements of some of the processes are still variable. For this last reason, and because of habit due to established custom, it is usual to allow the men periods of rest while on duty, with the result that the twelve-hour shift is not always over-taxing, and the eight-hour shift is sometimes too short from the economic standpoint to employ the energy of the men to the best advantage. But this is not always so: When the blast furnace "goes on a bum," when emergencies arise in other departments, and often when a mill runs without interruption and with unusual vigor, the eight-hour day is long enough for any workmen, and it is not uncommon to meet emergencies when all hands are occupied with severe labor and have scarcely any opportunities for a few minutes' rest for twelve consecutive hours.

In the majority of cases, however, labor at the blast furnaces and open-hearth furnaces is more or less variable and irregular. The more efficient, alert and careful the laborers, the less often will emergencies arise, and the fewer the

⁴ Besides Chapter XIX, see pages 228, 276.

⁵ For recent technical advances in the industry see pages 271 to 282.

break-downs. This has been urged as one of the advantages of the eight-hour day, because the men are more alert and efficient.*

Labor-Saving Devices and the Eight-Hour Day.

To work three crews instead of two crews per twenty-four hours involves the necessity of increasing the labor costs per day, unless daily wages per man are reduced, or unless we believe that any four men, working only eight hours per day can do as much work per hour as six men working twelve hours. It is obvious that the six men will be almost as efficient and productive per hour as the four men provided they have so much resting time as to keep them in good condition. Therefore, anything which tends to eliminate peak loads and idle periods increases the relative efficiency per day of the eight-hour men as compared with that of the twelve-hour men, and consequently decreases the added labor-cost per ton of working three shifts.

Labor-saving devices also reduce the labor-cost per ton, by actually eliminating some of the labor. This factor renders less serious an increase of the proportionate labor cost. (For example: If labor costs \$1 per ton on the twelve-hour system, and it must be increased by 20 per cent. to adopt the eight-hour system, then the increase will be twenty cents. But if, by means of labor-saving devices, the labor costs are reduced to sixty cents per ton on the twelve-hour system, then a 20 per cent. increase will only amount to twelve cents per ton.)

To the last argument the objection may be made that cost reductions due to labor-saving devices should benefit the stockholders rather than the workmen, but this suggests the general principle stated at the outset, namely: That the main object is to run the industry economically under com-

* See pages 274 and 275.

petitive conditions. The investigator has found that the majority of managers and executives interviewed believe that if by means of labor-saving devices the plant can be commercially operated upon an eight-hour shift system instead of a twelve-hour system, the good of the industry can be better served by eliminating the twelve-hour shift than by increasing dividends.

Instances of Commercial Success of Eight-Hour Day.

The circumstance that already many plants are operating successfully under competitive conditions on the three-shift system⁷ indicates that profits need not suffer, if the change is made with wisdom.⁸ Opponents of the three-shift system explain these instances by declaring that they find always some special condition in the case of every plant that employs successfully the three-shift system: Either, it is urged, such plants are owned by the interest that purchases their product, and so do not have to compete, or else they are making a special product at a special price, or they are geographically removed from the center of competition, etc. But this argument does not always hold; although it applies in many such cases.

Even if the argument did hold good, it would not prevent the experience of these plants applying generally in the industry, because there are special circumstances operating in every iron and steel district of the country, whereby each has an advantage or disadvantage in competition which is far greater than the labor cost per ton as influenced by this problem. For example, it is well known that the cost of labor which must work at the blast furnaces either on the twelve-hour shift or the eight-hour shift is well under one dollar per ton of pig iron. If this sum be doubled it would

⁷ See page 244.

⁸ See pages 241, 245.

still be small in comparison with the advantages some companies have because of wise purchasing policy, technical skill, low overhead and ample capital. Judge Gary testified before the Lockwood Committee in New York in June, 1922, that the U. S. Steel Corporation could produce at \$3 per ton less than its competitors.

Changing Systems—Necessary Conditions.

The experience of those who have made the change from the twelve-hour shift to the eight-hour shift with commercial success gives very definite information as to the conditions which must be prepared in advance in order to produce the desired result; they include:⁹

1. Having the equipment in satisfactory condition.
2. Assuring the cooperation of the men in the change.
3. Assuring that the necessary labor will be available.

Likewise this experience indicates what conditions must be avoided if the change is to be made without disaster to the industry.¹⁰ For example the change should not be made:

1. During a period of labor unrest.
2. After strife, or when bitterness is rife and mutual confidence is lacking.
3. When labor is arrogant, or elated by a defeat of the management.
4. In too sudden a manner.
5. Unless management is able to exert an influence upon labor to prevent tardiness, absence, deliberate shirking, misuse of the extra hours of free time, etc., inasmuch as laxity in these matters will defeat the commercial benefits of the Three-shift System.

⁹ They are discussed in full in Chapter XVII.

¹⁰ See pages 240, 241, and 245.

Groundless Fears of the Eight-Hour Shift.

It is said that some managers believe men to be more efficient on the twelve-hour shift than they would be on the shorter shift, and that they predicate this belief on their observation that the work is better done at the end of a long shift than at the beginning. The investigator never met a manager who took this position. In fact the position of every manager who has had experience with both systems has been that he invariably found the men more efficient on the shorter shift.

The fear has been expressed that, if twelve hours' pay were given for eight hours' work, the men would soon ask for twelve hours' work at the advanced hourly rate. Concerning this there is a difference of opinion, with a rather general agreement that foreign laborers want to make the most money that the work will bring, regardless of how many hours they labor, but that the better class of laborers, and especially Americans, are satisfied with the shorter day if it brings a living wage.

The remedy that has been applied with apparent success to the discontent which some show with the eight-hour shift is a very simple one, namely: Precede the change from twelve to eight hours' work by time observations to determine how much the crew would produce if working at some greater efficiency; then pay the same hourly rate for eight hours as for twelve, but add a bonus so adjusted that the men will earn the same daily wage as before, provided they work hard for eight hours. It is said with some positiveness that, if the crew works as diligently as it can for eight hours, none of its members will be agitating for twelve hours' work; and it is also said that the crew, itself, can be relied upon to see that every man does his work without shirking; disciplinary measures are not necessary for this

when a bonus depends on the result. The working of this plan was so good at one plant that the manager declares that eight hours' work with a bonus will pay for itself.

When wages are paid to the twelve-hour men on the tonnage basis, they have an incentive to work hard and it is not reasonable to expect any greater efficiency for eight hours' work, unless the men are actually more capable on the shorter shift.

Disadvantages of the Twelve-Hour Shift.

In some departments of the iron and steel industry twelve hours' work has been found too long for the men, and it is customary to have "spell hands" to relieve them at intervals.¹¹ In at least one case,¹² the crews are actually doubled, and each man works only one-half the time. Where the work is not so continuous, with peak and valley loads, the twelve-hour duty is not overtaxing, but another very serious objection arises. It is customary for the night men to work thirteen hours, and the day men, eleven hours; in cases of emergency at the furnaces (at the blast furnaces this is technically known as "going on a bum"), the night men, exhausted by thirteen hours of taxing labor, often find it impossible to get sufficient rest in their congested homes, especially in hot weather and when the children are at home from school.

In such a case it is not a matter of being exhausted by the labor, but of not having sufficient resting time between periods, so that they return to their work with lowered efficiency. On the eight-hour shift, they always have time to rest, and always some hours for sleep during darkness, when it is comparatively cool, and when the rest of the family is quiet.

¹¹ See page 263.

¹² See page 256.

Deliberately to permit laborers to loaf while on duty is wrong from the standpoint of morale and discipline. A few minutes' breathing spell after exertion may be wise, but the peak and valley loads of the iron and steel industry require more than this, when operating on the twelve-hour shift. Our tacit acceptance of the sight of men idling, resting, and even sleeping, on duty is a relic of the days before the severe labor was performed by mechanical appliances. We forget that the principle of sleeping during paid time is evidence of economic waste. At some plants, although sleeping on the night shift is not officially tolerated, the practice is allowed to go unobserved, when the men are not needed. With the three-shift system, rest or sleep during working hours is not necessary, even at the blast furnace.¹⁸

Advantages of the Eight-Hour Shift.

Results from working the eight-hour shift have disclosed the following advantages, which compensate in part for the extra cost of working three crews instead of two. It is not to be supposed that all of these advantages will be experienced in every case and in every department, but any of them may result when the hours of labor are reduced below twelve per day, in consequence of better care, better attention, better morale, or increased alertness or expertness on the part of the men:

1. Increased efficiency, due in part to better physical and mental condition of the men, and in part (after the industry has been working the shorter hours for several months or years) to a better class of men attracted by better working conditions. This increased efficiency has manifested itself in increased

¹⁸ See page 274.

production per man per hour and per machine per day, thus decreasing overhead expense. It has also appeared in better conduct of the operations, greater uniformity and regularity of operation and of quality of product, less fuel used, less waste, less need of repairs to equipment, better life of apparatus, etc.¹⁴

2. Better morale, resulting in less absences, less tardiness, less shirking, and better discipline. The better discipline is due in part to the spirit of the men, and in part to the pressure which the foreman can, and will, exert, because he does not have to hold back out of sympathy for tired men.¹⁵
3. Elimination of the "floating gang."¹⁶ This "floating gang" is an expedient, not a real remedy; it is an expense; it does not content the men, because it gives them their free day only occasionally on Sunday.
4. Finally,—an advantage which is not to be lightly considered,—in the event of labor disputes, the company which is working its men only eight hours a day enjoys much greater prestige with the public, whose influence in a labor dispute is always important. This influence may, indeed, be the factor which decides whether a strike is long and costly, or short and comparatively inexpensive. The twelve-hour shift,—even with resting periods,—leaves something to be explained to the public; necessitates a campaign of education at a time when the public is not always ready to be educated.

¹⁴ See pages 240 ff., 270 and 273.

¹⁵ See page 271.

¹⁶ See page 278.

Labor Costs.

It has often been pointed out that, in the ultimate analysis, the total cost of any manufactured product is composed chiefly of labor. To illustrate: Pig iron is made, by means of labor, out of ore, flux, and fuel. The cost of the materials used is far greater than the cost of the labor, but labor produced the ore, the flux, and the fuel; and so it can be shown that labor is the basis of all cost, if one goes back far enough. In the iron and steel industry, however, the proportion of the labor cost which is affected by the twelve-hour vs. the eight-hour shift is only a fraction of the total cost. To return to the illustration: The ore, the flux and the fuel does not represent any labor on the twelve-hour shift basis, except a fraction of the cost of the fuel in some cases.¹⁷ And the operating labor in the manufacture of pig iron is only from 5.5 per cent. to 8 per cent. of the total manufacturing cost, while that much of it which still works on the twelve-hour shift is a still lower percentage. So that those persons who argue, as some do, that the change from the twelve-hour to the eight-hour shift would affect an increase in 90 per cent. of the cost of the product, are dealing in generalities which will not bear analysis.

Likewise, in the case of the open-hearth furnace: At least 50 per cent. of the raw material used in the open-hearth is scrap, the price of which is determined by market conditions, and is not affected by any proposed change in the labor in the industry from twelve-hour to eight-hour shifts.

Finally, only a part of the laborers in the industry are working on a twelve-hour shift. If that proportion of the men were changed to the eight-hour shift, and paid as much per day as they are now receiving for twelve hours' work, without, at the same time securing any compensating eco-

¹⁷ See page 252.

nomic advantages through increased efficiency, increased morale, etc., the total manufacturing cost would be affected by not more than 15 per cent., perhaps by no more than 3 per cent. This is, in most cases, less than the variations in cost already experienced by plants competing with one another, because of efficiency of equipment, technical skill, wisdom in purchasing, location, capital resources, overhead expense, etc.¹⁸ If the increase in labor cost were compensated, at least in part, by resulting or accompanying economies in operation, the result would be correspondingly better.

As a matter of actual experience, it is known that some plants, or departments of plants, have changed from the twelve-hour to the eight-hour shift and reduced their labor costs.¹⁹ Others are operating on the eight-hour shift with satisfaction to their management and stockholders.²⁰ Others have changed and reduced their total manufacturing cost.²¹ Finally, there are other plants which have had experience with the eight-hour shift, the exact economic result of which is not known, but as to which there seems to be reason to believe that the total manufacturing cost, is at most, not much greater with the eight-hour than with the twelve-hour shift.²²

¹⁸ See especially page 254, and page 286.

¹⁹ See page 258.

²⁰ See pages 244, 275.

²¹ See pages 250, 260 ff.

²² See pages 263, 271 ff.

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